

Division of Aquatic and Wildlife Resources

Guam Department of Agriculture



Annual Report Fiscal Year 1993

Guam
Aquatic
and
Wildlife
Resources
Annual
Report
FY'93

ANNUAL REPORT FISCAL YEAR 1993

DIVISION OF AQUATIC & WILDLIFE RESOURCES

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GUAM DEPARTMENT OF AGRICULTURE

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PERIOD COVERED:

October 1, 1992 to September 30, 1993

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FY 1993

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The Marine Lab, University of Guam;

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Personnel from the Division of Law Enforcement, U.S. Fish and Wildlife Service, U.S. Department of the Interior.

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JOB PROGRESS REPORT COORDINATION PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-3C-1
SUB-PROJECT NO.: C-1
JOB NO.: 1

JOB TITLE: Coordination of Guam's Fish and Wildlife Programs (1630, 2630)

PERIOD COVERED: October 1, 1992 to September 30, 1993

OBJECTIVES

To plan, coordinate, supervise, and administer all fish and wildlife restoration and endangered species programs.

PROCEDURES

1. Supervise the planning and documentation of the Fish and Wildlife programs.
2. Administer all fiscal and budgetary matters and coordinate with the Central Accounting and Budget Office.
3. Administer all personnel matters including recruitment of off-island staff.
4. Represent the Division and Department of Agriculture in all matters pertaining to fish and wildlife resources.

RESULTS

The Division experienced several staff changes during the year, and has suffered a net loss of staff:

Administration: Janet Blas was promoted to the position of Administrative Officer. Deedee Rojas was hired as Word Processing Supervisor. Marvin Aguilar was promoted to Biologist II and continues to be assigned to the locally-funded Technical Assistance Program. Georgette Quitugua joined the staff as a Biologist I and was assigned to the Technical Assistance Program.

Wildlife: Wildlife Technician II Herman Muna and Wildlife Biological Aide Esther Arca resigned during the reporting period. Biologist I Tiffany Larscheid was hired and is assigned to the endangered species program. Mike Ritter has been reinstated to his former position of Biologist I, and is specializing in wetlands and the ecology of the Mariana common moorhen. Biologist I Josephine Perez was hired and is assigned half-time to the game management program and half-time to the Guam rail program. Luella Murray and Kara Wells were hired as Wildlife Technicians I, and are assigned to the Guam rail project. Biological Aide Benedict Reyes was promoted to Wildlife Technician I.

Fisheries: Fishery Technician George Mendiola was hired in January and Biologist I Tom Flores joined the staff in July.

Law Enforcement: Conservation Officers I Frankie C. Quinata, Richard M. Regadio, and George Arurang joined the Division during the reporting period. Conservation Officer Jimmy Camacho was promoted to Conservation Officer II (Sergeant). At the end of the reporting period there were three positions for Conservation Officer I yet to be filled.

At the end of the reporting period the Division had the following vacant positions:

- Wildlife Biologist III (Game Management)
- Wildlife Biologist III (Aviculture)--Selected, pending arrival on-island
- Wildlife Biologist III (Wetlands)
- Wildlife Biologist III (Brown Tree Snake)
- Wildlife Biologist II (Brown Tree Snake)
- Fisheries Biologist II (Non-fish)--Local funding, position frozen
- Fisheries Biologist III (Freshwater)
- Fisheries Biologist III (Data Processing)
- Fisheries Biologist III
- Fisheries Technician I
- Wildlife Technician II
- Wildlife Technician I (Brown Tree Snake)
- Wildlife Biological Aide
- Conservation Officer I
- Conservation Officer I
- Conservation Officer I

Division staff spent the first quarter preparing the annual Job Progress Reports on the research and other activities conducted during FY '92 under its various federal programs and submitted them to the U.S. Fish and Wildlife Service Regional Office.

Staff also devoted considerable effort to preparing the Federal Aid project documentation necessary to obligate funds for the Division's various programs during FY '93. This documentation included annual Project Agreements for the various Fish and Wildlife Investigations and Endangered Species activities that the Division conducts. At the request of both the Controller, Department of Administration and the funding agency, the U.S. Fish and Wildlife Service, the Division revised the former DJ/PR project FW-2R by splitting it into three new projects and also converted to the SMART-LINK electronic transfer system for cost reimbursement. The reason for this is to make for more efficient accounting of project costs. These changes took effect in FY'93.

The former project FW-2R was split into: 1) Project FW-3C, Guam Fish and Wildlife Coordination, which covers the administration and coordination of the Division's federal aid programs and which will continue to be jointly funded by wildlife (PR) and sport fisheries (DJ) funds; 2) Project F-1R, Guam Sport Fish Investigations, which covers sport fish research and survey activity and which will be funded with sport fisheries (DJ) funding; and 3) Project W-1R, Guam Wildlife Investigations, which covers wildlife research and survey activity and which will be funded with wildlife (PR) funds.

The Division's coordination and administration costs are now 50% covered by a local appropriation.

Considerable effort was devoted to coordination with the Government Accounting and Budget Offices to ensure fiscal integrity. Efforts continued to rectify a serious problem with an apparent overdraft within the DJ portion of FW-2R-28, which has never been closed out, as well as with E-1-6. It was determined that the proper adjustments had not been made for the across-the-board \$5440 pay raise granted in 1990 and the locally-funded

appropriation to cover a significant portion of the Division's administrative costs. These past accounts were reconstructed, the proper credits applied, and the projects prepared for closeout early in FY'94.

The Division Chief and his staff represented the Division and the Department of Agriculture in all matters relating to fish and wildlife resources. This frequently entailed meetings with other agencies of the Government of Guam, various Federal agencies, and the military.

The Division Chief served on the Department's Land Lease Approving Committee, which must review and approve all proposed leases of government land for agricultural purposes. He also serves as a member of the Territorial Land Use Commission. In addition, the Chief also serves as the Government of Guam's representative to the Western Pacific Regional Fisheries Management Council. The Chief is also a member of the Area Committee for Oil Spill Response

Division staff made a number of off-island trips related to Federal Aid programs:

Division Chief Rufo J. Lujan and Fisheries Supervisor Gerald W. Davis attended an emergency meeting of the Federal Data Coordinating Committee under the Western Pacific Regional Fisheries Management Council in Honolulu in October, 1992.

Division Chief Rufo J. Lujan traveled to Saipan for a November 6, 1992 meeting with Ernie Kosaka of the US Fish and Wildlife Service and Arnold Palacios, Chief of the Division of Fish and Wildlife, CNMI. The purpose of the meeting was to discuss proposed cooperative projects for the Guam rail, Mariana fruit bat, and the Mariana crow.

Division Chief Rufo J. Lujan attended the 79th meeting of the Western Pacific Regional Fisheries Management Council in Honolulu in November/December, 1992.

Gerald W. Davis, Fisheries Supervisor, attended the Bottomfish Plan Monitoring Team meeting in Honolulu March 16-17, 1993.

Fisheries Biologist Robert F. Myers attended the Pelagic Plan Monitoring Team meeting in Honolulu and later met with NMFS personnel to discuss data processing methodology in late March, 1993.

Division Chief Rufo J. Lujan represented the Governor of Guam at the 23rd Forum Fisheries Committee Meeting that was held in Palau May 6-12, 1993.

Division Chief Rufo J. Lujan, Assistant Chief Robert D. Anderson, Wildlife Supervisor Robert E. Beck, traveled to Saipan May 4 to meet with CNMI Division of Fish and Wildlife staff to discuss proposed cooperative projects.

Division Chief Rufo J. Lujan attended a Chairmen's Meeting of the Regional Fisheries Management Council in San Francisco in May, 1993.

Division Chief Rufo J. Lujan attended the Brown Tree Snake Control Group meeting in Honolulu May 20, 1993.

Assistant Chief Robert D. Anderson participated in a Brown Tree Snake Control workshop that was held on Saipan May 28, 1993.

Division Chief Rufo J. Lujan participated in the Third Regional Conference on Agricultural Development in the Commonwealth on Saipan June 10-12, 1993.

Biologist I Georgette Quitugua attended the Pacific Islands Nonpoint Source Implementation Workshop in Honolulu July 25-28, 1993.

Biologist III Celestino Aguon participated in an effort to capture Mariana crows on Rota with the US Fish and Wildlife Service, the Mariana Archipelago Rescue Survey Team, and the CNMI Division of Fish and Wildlife July 13-23, 1993.

Conservation Officers Sgt. Jimmy C. Camacho and Rudolpho Delfin attended a Motorboat Operators School sponsored by the National Marine Fisheries Service and held at the Federal Law Enforcement Training Center at Glynco, Georgia.

In addition to the above, Division Chief Rufo J. Lujan also represented Guam at several meetings of the South Pacific Applied Geotechnical Commission (SOPAC).

The Division hosted a number of off-island visitors during the year.

PROGRAM COST

The estimated cost of the Coordination/Administration project is \$130,900.

Report prepared by: Robert D. Anderson

JOB PROGRESS REPORT COORDINATION PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-3C-1
SUB-PROJECT NO.: C-2
JOB NO.: 1

JOB TITLE: Technical Guidance to Projects Affecting Guam's Fish and Wildlife Resources

PERIOD COVERED: October 1, 1992 to September 30, 1993

BACKGROUND

The Division of Aquatic & Wildlife Resources' (DAWR) professional staff devoted a significant percentage of their time and effort to technical assistance. The rapid pace of development on the island is requiring increasing amounts of time from the Division's staff to fulfill its statutory responsibility to review and comment on development plans, rezoning applications, and various permit applications. Because of the size and complexity of some of these developments, the Division's review responsibility will require a continuing commitment that could extend even beyond project completion.

In response to the increase in workload, the Division created the Technical Assistance Program (TAP) within the Administration/Coordination Section. A local appropriation provides funding for two technical assistance staff members, a Biologist I and a Biologist II. These staff are primarily responsible for reviewing projects submitted to the Development Review Committee for action by the Territorial Land Use Commission and for the review of clearing and grading permit applications, but they also participate in the review of other permit applications and environmental documentation. The other professional staff provide technical support to the TAP staff, and occasionally take the lead in the review of projects involving their particular expertise, such as those that may have endangered species impacts and those involving wetlands. In the case of the administrative staff under this Coordination Project, all of whom are at least 50% locally funded, participation in technical assistance included supervisory and administrative support for TAP and the technical assistance activities of the other professional staff as well as direct participation in project review, field inspection, and formulation of recommendations.

OBJECTIVES

1. To minimize adverse environmental impact resulting from the construction of recreational, commercial, residential, industrial or public utility facilities.
2. Provide technical assistance to military and civil agencies relative to the management and protection of fish and wildlife resources.

FINDINGS

Division staff have been actively involved in the technical guidance function during this segment. Numerous development plans, impact statements, and permit applications have

been submitted to the Division for review. Field investigations and meetings with responsible agencies have been conducted in many cases as a part of the review process.

Various Division staff members actively serve as members of the following groups:

1. Ad Hoc Fisheries Council
2. Region IX Regional Response Team - Oceania
3. Development Review Committee
4. Fish and Wildlife Conservation Committee- Andersen Air Force Base
5. Western Pacific Regional Fisheries Management Council
6. Recreational Water Use Master Plan
7. Western Pacific Regional Pelagic Plan Monitoring Team
8. Western Pacific Regional Bottomfish Plan Monitoring Team
9. Guam Aquarium Council
10. Seashore Protection Plan Task Force
11. Bird Aircraft Strike Hazard Committee - Andersen Air Force Base
12. Criminal Justice Craft Committee--Guam Community College
13. Area Committee for Oil Spills
14. Agricultural Lease Approving Committee
15. Territorial Land Use Commission
16. I Tano'-ta Land Use Plan Technical Advisory Committee
17. Pacific Islands Nonpoint Source Implementation Task Force
18. Pacific Regional Marine Research Board
19. South Pacific Applied Geosciences Commission
20. South Pacific Commission Regional Fisheries Program
21. International Association of Fish and Wildlife Agencies
22. Interagency Agreement Coordinating Committee on the Brown Tree Snake
23. Brown Tree Snake Task Force
24. Andersen Air Force Base Installation Restoration Program Technical Review Committee

25. Navy Installation Restoration Program Technical Review Committee

Members of the Division have attended numerous meetings and hearings pertaining to the protection of Guam's natural resources and have actively consulted with various civil and military agencies on environmental matters. Division staff maintain close liaison with the Department of Land Management, Department of Parks and Recreation, Guam Bureau of Planning, Guam Environmental Protection Agency, University of Guam, U.S. Army Corps of Engineers (ACOE), U.S. Fish and Wildlife Service, Western Pacific Regional Fisheries Management Council, National Marine Fisheries Service, U.S. Navy, the U.S. Coast Guard, and U.S. Air Force regarding matters of environmental concern. In addition, staff members actively consulted with the numerous off-island visitors, representing various agencies and organizations, who visited during the segment.

Considerable public contact was maintained by Division staff during the reporting segment. In addition to occasional interviews on radio, television, and in newspaper, staff members participated in National Wildlife Week, Chamorro Week, Earth Week and Environmental Fair activities and gave talks to a number of civic groups, sportsman clubs, and school and university classes.

Some specific Technical Assistance activities provided by Division staff included:

1. Representation of the Department of Agriculture on the Development Review Committee, which met bi-weekly to review applications for rezoning, variances, and various types of development. The Division's input at this level is very important in ensuring that the protection of Guam's fish and wildlife resources be considered in land use planning. The DRC entertained 114 applications during FY'92.
2. Review and comment on ACOE applications for wetland fill for the Island Equipment Company's proposed industrial park in the Atantano wetland. The Division worked closely with the consultant in developing a mitigation plan that will avoid net loss of wetland and that will provide enhanced wetland habitat for the endangered Marianas common moorhen.
3. Review and comment on the proposal by the Talofoto Golf Resort to repair typhoon-caused slides and erosion by filling a steep ravine between Fairways No. 12 and 16. Mitigation recommendations were included in those comments.
4. Participation in site inspections with local and federal enforcement agencies regarding several wetland violations and provided appropriate comments.
5. Involvement in the various issues related to the proposed Guam National Wildlife Refuge, including participation in the extensive drafting and review process for the various memoranda of understanding and cooperative agreements.
6. Involvement in attempting to resolve the uncertainties regarding the Division's attempts to reserve Government of Guam land for conservation purposes in light of the implementation of the Chamorro Land Trust Act.
7. Providing Federal Consistency Review comments to the Guam Coastal Management Program at the Bureau of Planning for several projects including:
 - a. The Agana River Flood Control Project.
 - b. Various road enhancement/renovation projects.

- c. The proposed Alupang Beach Club dredging project.
 - d. A proposal to construct an aquaculture facility on the Asinan River.
8. Participation with both federal and local agencies in several wetlands delineation surveys including the Pagachao "Land for the Landless" Sub-division. Division staff also made mitigation recommendations regarding these projects.
 9. Review and comment on numerous Environmental Impact Statements and Assessments of proposed developments. These comments included recommendations for grading and clearing, erosion control, project design and orientation. These recommendations were made to reduce and/or eliminate impacts to the immediate and adjacent environments.
 10. The Division's Wildlife Section provided comments at the request of the USFWS involving several Section 7 Consultations under the Endangered Species Act.
 11. The Division's Wildlife and Fisheries Sections provided assistance and information to the Technical Assistance Program on various area of significant environmental concern.
 12. Additional review and comment on the proposed ABC Condominium Dredging Project and revisions thereof.
 13. Continued review and compliance monitoring for a number of permitted development activities on Cocos Island by the Cocos Lagoon Development Corporation (CLDC). These included the masterplan modification for the Cocos Island Resort, CLDC use of the Government of Guam LCM ramp, the periodic maintenance dredging in the channel for an existing LCM ramp as well as an after the fact permit for the existing ramp, construction of a concrete and wooden cabana structure, construction of a jet ski ramp, installation of five storm moorings in Cocos Lagoon, and construction of new LCM ramp at Cocos Island. Particular attention has been given to CLDC's attempts restore the the northern portion of Cocos Island by recovery of sand washed off the island by Typhoons Russ and Yuri, construction of an additional seawall on the seaward side of the island to provide protection against future storm wave damage, and removal of post-typhoon debris. The prime concern in the review of all these activities was their potential impact on the existing avian colonies and on sea turtle nesting.
 14. Continued participation with, and provision of comments and assistance to, the Guam Environmental Protection Agency and the Office of the Attorney General in negotiations with Miyama Development Incorporated (MDI) regarding water rights issues.
 15. Provision of comments and information to, and participation in, the Western Pacific Regional Fisheries Management Council (WESPAC) and the Plan Monitoring Team (PMT) on projects for bottom and pelagic fisheries. Information was provided on market sampling, biomass and stock assessment, historical and current transshipment from foreign and domestic vessels, recreational and near-water commercial vessels and public service announcements.
 16. Review and comment on several legislative bills that would affect fish and wildlife.

17. Review and comment on several proposals to dispose of government land through sale, exchange or lease and made appropriate recommendations for the conservation of wildlife resources.
18. Participation with other Government agencies in the Recreational Water Use Master Plan to resolve problems of user conflict between mechanized craft and fishermen in Guams inshore waters.
19. Investigation of several reports of suspected fish kills in island waters during the year.
20. Response to many requests for information on laws and regulations pertaining to fish, wildlife, endangered species, hunting and fishing and importation of wildlife.
21. Response to many requests for information on native wildlife, particularly endangered species.
22. Answering numerous requests for information on hunting from both on and off-island individuals. Specific requests included information on hunting areas, hunter safety classes, firearms regulations, hunting seasons and limits, and laws and regulations.
23. Provision of technical assistance to numerous farmers, the Air Force, and the Navy regarding pig damage. Damage control permits were issued when warranted.
24. Review of manuscripts for other authors and for professional journals.
25. Provision of technical assistance to the Attorney General's Office in interpreting the laws and regulations that apply to fish and wildlife resources. In addition, the Division requested for several legal opinions in regards to environmental issues.
26. Attending hunter safety briefings at Anderson Air Force Base and the Mangilao Community Center to provide pertinent information to hunters.
27. Numerous presentations on fish and wildlife resources at meetings of numerous and other organizations during the year.
28. Preparation of numerous press releases to keep the public informed of fish and wildlife issues including hunting and hunting seasons, Brown Tree Snake issues, fish and wildlife laws and regulations, endangered species, fish and wildlife importation, etc.
29. Provision of technical assistance to the Guam International Fishing Derby.
30. Provision of technical assistance and logistical support to various U.S. Fish and Wildlife Service personnel working on the brown tree snake problem.
31. The Division, at the request of numerous developers, met with them, their consultants and other government representatives to discuss their proposed development and its possible impacts on endangered species, wetlands and native habitat as well as erosion, project design, etc.

32. Provision of technical assistance to U.S. Fish and Wildlife Service and National Marine Fisheries Service law enforcement personnel on various matters including the importation of endangered species items.
33. Provision of technical assistance to the Republic of Palau regarding fish aggregating devices (FADS).
34. Assisting mandated Government of Guam Departments/Agencies in monitoring and inspecting conditions imposed in permits approved by the Territorial Land Use Commission and the Territorial Seashore Protection Committee. Comments on violations were submitted to various Government of Guam departments/agency for review and action.
35. In collaboration with GEPA, the Division has reviewed and submitted comments on 84 Government of Guam Clearing and Grading permit applications.
36. Submission of 94 position statements on various submerged land/land use issues as per requirement by the Government of Guam Development Review Committee.
37. Provision of comments to the Government of Guam Bureau of Planning regarding Federal Consistency Application for the structural improvement of X, Y, and V Pier at Apra Harbor, to include improvements by dredging at Reserve Craft Beach and the Commercial Port.
38. Provision of comments to the Regional Fisheries Training Project regarding the draft South Pacific Commission, Fisheries Human Resources Survey Guam Report.
39. Provision of statistical data on fish and wildlife issues to the Bureau of Planning and Department of Commerce as supplemental information for local annual reports.
40. Continued review of the Habitat and Reclamation Plan for the Talofofo Fish ponds.
41. Participation in meetings and submitted recommendations on U.S. Navy's proposal to refurbish mooring for mooring buoys in Apra Harbor. Also, provided comments and collaboration with GEPA and University of Guam, Marine Lab on the protection and assessment of damaged coral and sponge flats.
42. Participation in Mine Exercises conducted by U.S. Navy.
43. Provision of comments to the Department of Land Management regarding the proposed land lease of government land at Oka Point, Tumon.
44. Review and comment on various drafts regarding the I Tano Ta Land Use Plan proposal to implement new land use alternative through performance standards.
45. Review and comment on the Guam Telephone Agency proposal to erect a cellular phone antenna on Mount Sasalaguan.
46. Continued involvement in the review process for several proposed golf course developments that are in various stages of permitting and development. These include the Talofofo Golf Resort, Manengon Hills Resort, STT Golf Resort, Cascada Golf Resort, Guahan Golf Resort, Tinechong Golf Course (FBD), Dan Dan Estates, Guam First Green Golf Course, and the Bubulao Golf Course.

RECOMMENDATIONS

Continue technical assistance activities but allocate the federal costs involved between F-1R and W-1R.

PROGRAM COST

The estimated cost of the Technical Assistance project under FW-3C-1 is \$12,705.

Report prepared by: Robert D. Anderson, Marvin Aguilar, and Georgette Quitugua

JOB PROGRESS REPORT INFORMATION/EDUCATION SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-3C-1
SUB-PROJECT NO.: C-3
JOB NO.: 1

JOB TITLE: Public Information and Education on Guam's Fish and Wildlife Restoration and Endangered Species Programs (2520, 2530, 1630)

PERIOD COVERED: October 1, 1992 to September 30, 1993

SUMMARY

In Fiscal Year '93, the Division's Public Awareness and Conservation Program saw a 9% increase (from 2256 to 2459) in the number of school-age children who were covered under the school visitation program. The increase reflects the program's expansion to other youth-oriented activities such as Boy and Girl Scout Clubs of America and the newly-established Department of Education Extended Day Program (DEED), an after-school program for schoolchildren whose parents both work.

Of the 2459 youths, about 2,000 came from 12 elementary, 3 middle and 5 high schools (55 elementary, 10 middle and 16 high school classrooms). The remainder came from the Department of Parks and Recreation Summer Camp, the Summersault Camp, the Boy and Girl Scouts of America and the DEED program.

The Fena Lake Fishing Derby (For Kids Only), conducted on the U. S. Naval Magazine during the past two fiscal years, was postponed until early January 1994. The low water level at the lake made it unsafe and unfeasible to conduct a derby and the Division felt it best to postpone the event until conditions are more suitable. In addition, the Magazine saw a change of command and thus was not able to arrange a planning meeting until the new Commander had had a chance to review the merits of the program.

The Division also did not conduct a marine derby due to a lack of staff and a designated derby site which would facilitate as many anglers as possible. DAWR derby planners hope to resolve this problem during the ensuing fiscal year.

An estimated 10,000 to 15,000 residents viewed Division displays during Earth Week, Clean Water Week, Chamorro Week, and Law Enforcement Week. The Division also participated as speakers and judges in various radio and television talk shows, school science fairs, career day, and fisheries workshops. Television Public Service Announcements continue to be aired, although sporadically, on public and network television.

Lastly, the Division finalized the drafts and secured purchase orders for the printing of foodfish posters (a joint project with the Commonwealth of the Northern Marianas). The layouts for the aquatic and wildlife flyers were approved and funding for the printing was secured through a grant from the Guam Coastal Management Program, administered by the Government of Guam Bureau of Planning.

BACKGROUND

The DAWR Public Awareness and Conservation Education Program (PACE) was established in conjunction with DAWR's mission to protect, preserve, develop and enhance Guam's aquatic and wildlife resources. The program consists primarily of school presentations, public service announcements, press conferences and news releases, public displays, periodical newspaper columns, feature articles, information pamphlets, coloring books and activity guides for elementary school children.

In FY '90, the PACE program was expanded to include the Division's Conservation Officers (COs) as school presenters, thus allowing more schools to be covered and addressing the enforcement aspects of resource conservation.

The effectiveness of these programs and activities can best be measured by the community's continuing response in reporting suspected poachers and poaching activities to conservation officers and police, and the increase in teacher and community requests for fish and wildlife presentations. As in the past, residents continue to report bird sightings, bring in injured birds or birds presumed to be endangered species, and generally to encourage the institution of more intensive management programs for Guam's fish and wildlife resources.

PROCEDURES AND RESULTS

To date, activities and efforts include;

1. Class presentations on endangered species, coral reef ecology, and general resource conservation were delivered to 2,459 youths from 81 elementary, middle and high school classrooms, participants from summer youth camp sessions operated by the Department of Parks and Recreation, the Summersault Camp, the DEED Program, and boy and girl scout organizations. Audiences comprised youths of ages four to 17. Presentations were complemented by a display of live and preserved animals, followed by a question-and-answer period.
2. Displays on the brown tree snake and fish and wildlife conservation were shown during Earth Week, Clean Water Week, Chamorro Week, and Law Enforcement Week. An estimated 10,000 to 15,000 residents viewed the displays.
3. Completion of layout and translation of Chamorro names for the joint fish poster (Guam and the CNMI) and 84 aquatic and wildlife flyers for dissemination to public and private school classrooms and the general public.
4. PSAs continue to be aired, albeit sporadically, on network and public television, and Division programs and activities continue to gain extensive media coverage. Radio and television appearances this year included the Jesus Chamorro Show, Cable Forum, Talk 57 and Cop Talk, the first three dealing with the Guam National Wildlife Refuge proposal and the last on hunting and fishing regulations.
5. Division participation in Student Career Day, Science Fairs and Youth Leadership Day activities at various high schools.
6. The distribution of nearly 4,000 sets of bird posters to all public and private schools, libraries, departmental offices, hospitals, hotels and other institutions. About 1,000 posters were issued upon request to various individuals throughout the year.

7. Development of press releases, feature articles and media conferences focusing on status and progress of DAWR programs and activities.
8. Administrative duties as assigned by the Division Chief and Assistant Chief.

RECOMMENDATIONS

1. Implement the Guam Aquatic Education Leadership Workshop for public and private school teachers. The course outline has been completed and all that remains is the completion of the coral reefs workbook and video currently being produced by the Pacific Islands Aquatic Resources Education group, headed by Hawaii representative Randy Honebrink.
2. Complete the development of a 30-minute video focusing specifically on Guam's coral reefs. The video will be produced for the Division by graduate students at the Marine Lab, University of Guam for use in and the enhancement of class presentations.
3. Develop a similar 30-minute educational video on endangered native species and general wildlife conservation for use in and the enhancement of class presentations.
4. Immediately conduct both freshwater and marine derbies for kids. The kids' fishing derbies, which were established in FY'91 to promote fishing as a form of recreation and to instill a conservation ethic among school-age children, have become increasingly popular with 7-12 year olds and suggestions have been made to conduct similar derbies for older youths and perhaps initiate a freshwater derby for adults.
5. Conduct fishing clinics to increase public interest in fishing as a form of recreation.
6. Recruit an additional staff person to assist the Public Information Officer in facilitating the numerous requests for class presentations and in the implementation and coordination of a more comprehensive conservation education program, including but not limited to, aquatic education and hunter education.
7. Continue aquatic and wildlife presentations at public and private schools, libraries, summer camps, after-school programs and other organizations.
8. Continue public awareness programs through press releases, news articles, press conferences and other media to keep the public informed of the progress and accomplishments of the Division's fish, wildlife and endangered species programs.
9. Erect interpretive signs at major beaches throughout Guam and other sites with frequent coral and fishing violations.
10. Update and develop new PSAs for television and radio.
11. Print posters focusing on the conservation of the Mariana fruit bat.
12. Encourage and support the creation and actively participate in an environmental education and information network.
13. Coordinate the Division's participation in mutual programs and projects with Guam's Department of Education, Guam Coastal Management Program, Sea Grant, the University of Guam Extension Service, Department of Parks and Recreation, the

Guam Environmental Protection Agency, the U.S. Fish and Wildlife Service, and the U.S. National Park Service.

PROGRAM COST

The estimated cost of the Division's PACE Program under FW-3C-2 is approximately \$30,800.

Report prepared by: Lillian L. Mariano

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: F-1R-1
SUB-PROJECT NO.: F-1
STUDY NO.: 1
JOB NO.: 1

STUDY 1: Fisheries Participation, Effort, and Harvest Surveys (2430)

JOB 1: Offshore Fisheries Survey

PERIOD COVERED: October 1, 1992 to September 30, 1993

SUMMARY

Monthly offshore fisheries surveys were conducted at the Agana Boat Basin and other boat launching locations along Guam's shoreline from October 1992 through September 1993. An island-wide finfish catch from small recreational-type vessels was estimated at 431.1 metric tons (MT) for that period. An estimated 302,651 person-hours were spent during 83,968 boat-hours of fishing. The bulk of the catch, 367.7 MT, was landed by trolling during an estimated 64,218 boat-hours of effort. Nearly all of the troll catch, 97.2%, consisted of five major pelagic species. Bottomfishing produced an estimated 25.4 MT, and night-light jigging for atulai produced an estimated 11.4 MT. Spearfishing produced 20.7 MT of finfishes and shellfish. Approximately 6.1 MT of finfish and shellfish were caught by spin-casting, hand, nets, or ikashibi. Catches by infrequently encountered methods may be under-estimated as follows: bottomfishing (1%); spearfishing (10%); night light jigging for atulai (5%); and all other methods combined (36%).

BACKGROUND

Effective management of the island's offshore fishery resources requires accumulating data on fishing pressure, types of fishing methods used and annual harvest. In order to identify trends in fishing participation, effort, and catch, the Division of Aquatic and Wildlife Resources (DAWR) has been monitoring offshore fishing activities for the past 15 years. Over this period of time, survey and analysis methodologies have changed in response to fluctuations in budget and staff. During the early 1980s major advances were made in both field survey techniques and in the area of computerized statistical analysis. The combined efforts of DAWR and National Marine Fisheries Service (NMFS) personnel through the Western Pacific Fisheries Information Network (WPACFIN) program (see Study F-1, Job 3) made it possible to employ computerized statistical analysis for the period FY'77-91. However, statistics could not be computed for FY'92-93 estimates due to attrition of critical staff and the breakdown of computer hardware.

OBJECTIVES

To establish baseline catch and effort data for reef fish, bottomfish and pelagic species necessary to develop a fisheries management plan for Guam and to gather limited biological data on these fisheries.

PROCEDURES

During FY'93, interviews of returning offshore fishing parties were conducted on four days each month at the Agana Boat Basin. Two of these days were randomly selected weekdays and two were randomly selected weekend days (which, in this report, includes holidays). Each survey consisted of two periods, one from 0500 to 1200 hours (previously to only 1100 hours) and the other from 1600 to 2400 hours. In addition, interviews from the southern launching site of Merizo Pier were obtained on one day per month, alternating between weekdays and weekends from the hours of 0600 to 1100 and 1600 to 2000. Island-wide participation was determined by means of a morning and evening survey of all public boat launching areas in which all trailers attached to vehicles were counted, but no interviews were taken. This assumes that the proportion of boat trips participating in fishing to boat trips not participating in fishing as well as the proportion of boats engaging in each method for boats utilizing the Agana Boat Basin is representative of the island as a whole.

Sampling and analytical procedures used in the GOES (Guam Offshore Expansion System) remain unchanged from those of recent years. However, drastic attrition in critical staff again has made it impractical to employ the GOES during FY'93. Preliminary estimates without statistical analysis were determined through the use of a computerized spreadsheet. The following steps were taken to obtain monthly estimates of total participation, effort, catch, and total number and weight for the five major trolling species (mahimahi, wahoo, skipjack tuna, yellowfin tuna, and blue marlin) for each method:

1. Participation, effort, catch, and total number and weight for the five major trolling species (mahimahi, wahoo, skipjack tuna, yellowfin tuna, and blue marlin) for each method and returning boat were summed for each survey day.
2. Totals for each survey day were divided by that days P1 and P2 values to obtain an island-wide estimate. The method for determining P1 and P2 values remained unchanged from that of previous years.
3. The average of each daily parameter for each type day (weekday [WD] or weekend/holiday [WE/H]), was multiplied by the number of each type day in the month to obtain WD and WE/H monthly estimates. WD and WE/H totals were summed to obtain monthly totals.
4. Estimates for the month of July and for the year for trolling and bottomfishing are based on a 28-day expansion, with the Guam International Fishing Derby (GIFD) results added for trolling (Appendix).
5. Summary estimates for the remaining methods are based on 31-day and 365-day expansions for July and the year, respectively. Other one and two-day derbies with relatively low turnouts were not considered separately from the normal expansion.
6. The method used to assess the degree of under-sampling remained unchanged from that of the previous year.

RESULTS

Trolling

Including the Guam International Fishing Derby (GIFD; Appendix 1), an estimated 367.7 MT of troll-caught fish were landed island-wide during FY'93 (Table 1). An estimated

64,218 boat-hours were spent trolling with an average catch rate of 5.7 kg/boat-hour. Monthly catch rates as catch per unit of effort (CPUE), ranged from 2.2 kg/boat-hour in July to 9.0 kg/boat-hour in February.

The usual five pelagic species accounted for the bulk of the catch (97.2%; Table 2). Mahimahi (*Coryphaena hippurus*) accounted for nearly half of the landings (48.9%) followed by skipjack tuna (*Katsuwonus pelamis*, 18.6%), yellowfin tuna (*Thunnus albacares*; 11.3%), wahoo (*Acanthocybium solandri*; 9.7%), and blue marlin (*Makaira nigricans*; 8.7%).

The estimated troll fisheries catch for FY'93 was 26% larger than the preceding years catch and matched the record catch of FY'91. This can be attributed primarily to the extended run of mahimahi (179.8 MT) which was more than three times that of last year. The skipjack tuna catch was about 16% higher than that of last year, but the blue marlin catch of 32.0 MT was only about half that of the last three years and catches of wahoo and yellowfin tuna catches were down by 29% and 25%, respectively.

The estimated number of boat hours spent fishing (64,218) was essentially unchanged from that of last year, but other measures of participation and effort (63,120 person trips and 248,090 person hours) were 14 to 16% lower than the record levels estimated for FY'92. This combined with the relatively good catch of mahimahi contributed greatly to an overall catch rate of 5.7 kg/boat hour, some (23%) higher than that of the preceeding year. However, lower catches of wahoo, yellowfin tuna, and blue marlin kept this figure below the record figure of 6.2 kg/boat hour set in FY'91. The sharp decline in the catch of blue marlin is most likely due to a combination of lower availability and a slowdown in the charter boat segment of the fishery due to sharply lower visitor arrivals. Charter vessels generally carry more people but spend less time fishing per trip than non-charter vessels. Their larger size enables them to go out more often during marginal weather conditions and they target marlin more frequently than non-charter vessels. However, without a separate analysis of the charter boat segment of the fishery, it is not possible to determine either the magnitude of the decrease in charter activity or the extent that it played in causing lower marlin catches.

Bottomfishing

An estimated 25.4 MT of bottomfishes were landed island-wide during FY'93 (Table 3). Estimated monthly catches ranged from a high of 7.8 MT in July to a low of 32 kg in February. Bottomfish landings fluctuated widely, with catches of less than 1 MT occurring in December, February, April, and May. An estimated 34,475 person-hours were spent during 12,665 boat-hours of bottomfishing, resulting in an overall catch rate of 2.0 kg/boat-hour. Monthly catch rates ranged from 0.3 kg/boat-hour in February to 4.1 kg/boat-hour in April.

Estimated bottomfishing participation and effort for FY'93 were slightly higher than those of the past two years, but the catch remained about the same, resulting in a lower catch rate. Composition of the FY'93 catch has not been determined, but is not expected to differ significantly from that of the past few years. It is believed that the expansion method used underestimated the participation, effort, and catch for this method by about 1%.

Spearfishing

Estimated monthly and annual participation, effort, and catch for spearfishing from boats during FY'93 are summarized in Table 4. (Readers should also refer to Study F-1, Job 2

for estimates of spearing from shore, i.e., without the use of boats, to gain a more complete picture of FY'93 spearfishing activities on Guam.)

An estimated record 20.7 MT of speared fish, crustaceans, and mollusks were landed from boats during FY'93. This was 28% more than that of the preceding year and considerably higher than catches of most other recent years.

The bulk of the catch (67.6%) was taken by scuba diving although more effort in terms of person-hours (5,921 vs. 5,077) was attributed to snorkeling. The overall catch rate for spearfishing in FY'93 was 1.9 kg/person hour with the catch rate by scuba diving more than twice that by snorkeling (2.8 vs 1.1 kg/boat hour). This is consistent with the pattern during the preceding year. Although no confidence limits could be placed on the FY'93 estimates, few of the differences between annual estimates in recent years are significant at even the 90% level of confidence. Composition of the FY'93 catch has not been determined, but is not expected to differ significantly from that of the past few years. It is believed that the expansion method used underestimated the participation, effort, and catch for this method by about 10%.

Atulai Night-Light Jigging

Atulai (*Selar crumenophthalmus*) fishing was encountered during the months of October, November and April through September. An estimated 11.4 MT of fishes were landed by night-light jigging during 2,574 boat-hours of effort during FY'93. These figures are 60% and 53% higher than last year's respectively. This is consistent with a pattern of wide fluctuations in catch, effort, and catch rates for this fishery. Although composition has not yet been determined, nearly all of the observed catch consisted of atulai (*Selar crumenophthalmus*). It is believed that the expansion method used underestimated the participation, effort, and catch for this method by about 5%.

Other Methods

Other rarely encountered methods during FY'91 included ikashibi, gill-netting, cast-netting, spin-casting from an anchored boat, and by hand (the latter method may utilize a knife or hand tool or no equipment at all). Together, they produced an estimated catch of 6.1 MT of finfishes and shellfish during 750 boat-hours and 1,735 person-hours of effort. However, the bulk of the catch (59%) but only 43 boat hours and 86 person hours of effort were due to the expansion of a single ikashibi interview. Of the remaining methods, 815 person hours of gill netting produced a catch of 2.0 MT, 489 hours of cast netting produced a catch of 0.5 MT, and 345 person hours of spin casting produced a catch of 86 kg. It is believed that the expansion method used underestimated the participation, effort, and catch for gill netting by about 36%.

RECOMMENDATIONS

There is little doubt that the reliability of estimates of island-wide catch and effort based on the present survey is limited by the quality of participation data taken at sites other than the Agana Boat Basin under the assumption that activity as well as catches landed there are representative of the island as a whole. However, data collected at Merizo Pier during FY'89-'93 indicates that this is not the case, but that there is proportionately much less trolling activity and much more bottomfishing, spearfishing, and gillnet activity occurring there. We still do not have a clear idea how much boating participation takes place from less accessible landings (e.g. the private Achang Bay Marina), nor do we know the proportionality of the various methods at these areas or at the Agat Marina. Island-wide estimates for the past several years are therefore disproportionately high for trolling, but

low for other methods. Since these other methods are the only ones that are locally manageable, it is imperative that the survey results be unbiased as well as based on an adequate sample of interviews from launch sites other than the Agana Boat Basin. Separate expansions for the Agana Boat Basin and other boat launching sites would be desirable. It will also be necessary to reassess annual island-wide estimates of catch and effort as far back as possible.

Since all major trolling species have broadly distributed stocks, some of which are believed to be Pacific-wide, meaningful management and conservation of these resources will only be possible by international regional cooperation. This will require that data bases be made available from as many sources and areas as possible, and that any biological assessment be based on adequate region-wide data. There are presently few areas from which adequate data on recreational or subsistence fisheries are available, significant gaps in the data for both foreign and domestic distant-water fisheries, and virtually no information on the interaction of recreational and large-scale commercial fisheries in the western Pacific. It is therefore essential that the current time-series of data from Guam be maintained. Since Guam's recreational troll fishery is incapable of taking more than a fraction of a percent of these stocks and could not have an adverse affect on them, and since the activities of both domestic and foreign large-scale commercial fisheries can significantly affect the performance of Guam's recreational fishery, it is imperative that Guam's recreational fisheries interests be represented and protected in any regional forum.

The recent trend of sharply increased catches for spearfishing while using scuba equipment appears to be a direct result of a small core of commercial spearfishermen concentrating their efforts in waters over 30 m deep, primarily at night. Many of the targeted species are also important in shallower inshore fisheries where they have become depleted. Unlimited spearfishing with the use of scuba, particularly at night, is a potentially serious threat to the well-being of many reef fish species and their fisheries. This is particularly true for diurnal herbivores such as parrotfishes, surgeonfishes, and unicornfishes that sleep at night and generally do not occur beyond the range of scuba. Without a working data base, it is difficult to monitor the status of reef fish fisheries or to determine the degree of interaction between them.

In order to effectively manage those fisheries that are specific to Guam, or to Guam and nearby islands and banks, additional biological information is needed on major bottom- and spearfished species. The offshore survey is currently too infrequent to obtain sufficient data to perform certain length-based analyses of any of these species. It is recommended that separate studies of the major bottomfish species be implemented that examine reproduction and ecology as well as length-frequency distributions. Comparisons with the inshore survey will have to be made to determine which spearfished species require further study.

In order to address the problems described above, the following projects have been implemented or proposed:

1. The GOES program will be rewritten and modified for use on the data base software "4th Dimension" on the Fishery Section's Macintosh SE/30 computer system. Dr. Steven Amesbury of the University of Guam Marine Laboratory is currently under contract to prepare the new GOES program. Modifications expected in the GOES will: (1) enable the program to produce more accurate expansions that factor in days in which a given method occurred but no interviews were obtained; (2) produce separate estimates for shallow- and deepwater bottomfisheries; and (3) use additional location codes to more accurately distinguish between trips that include or exclude offshore banks. The software and hardware itself will greatly reduce the time needed to produce expansions as well as greatly reduce risks of input or transcription errors by making it possible to save subsets and files

without having to re-enter variables, and by eliminating the need for dumping compiled summary data on other software in order to produce tables and charts. This will make it possible to quickly and efficiently examine many aspects of the data base that are impractical to exam under the current system as well as make it possible to re-expand the historic data base using more accurate information on participation.

2. A separate, intensive study of island-wide participation in small-boat fisheries on a method and area-specific basis in order to produce more accurate island-wide expansions should be conducted.

3. Studies of the major bottomfish species *Epinephelus fasciatus*, *Variola louti*, and *Lethrinus rubrioperculatus* that examine reproduction and ecology as well as length-frequency distributions to be initiated under the D-J funded project "Studies of Recreationally Important Reef Fish" (project no. F-1R Job F-1).

4. An increase in staffing to adequately cover the Agat Marina and other launch sites while maintaining the current level of coverage at the Agana Boat Basin.

Therefore, we recommend that this job continue, that sampling techniques continue to be refined or expanded as necessary, and that historic annual estimates of catch and effort be reassessed. We also recommend that staff fisheries biologists continue to work closely with NMFS personnel in improving the efficiency and accuracy of our computerized data analysis techniques, and that they take an active roll in regional management activities through the Council and other regional organizations.

PROGRAM COSTS

The estimated cost of the Offshore Fisheries Survey Project under F-1R-1 is approximately \$101,114.

Report prepared by Robert F. Myers

Table 1. Estimated monthly trolling participation, effort, and catch during FY'93. Estimates include the Guam International Fishing Derby (GIFD). Weights are in kilograms (1 Kg = 2.2046 lbs).

MONTH	No. of Persons	No. of Boat hours	No. of Person hours	No. of Kilograms	Kg/ per- son	Kg/ boat- hour	Kg/ person- hour
OCT	4,920	4,694	19,413	14,603	3.0	3.1	0.8
NOV	2,935	3,793	13,596	27,267	9.3	7.2	2.0
DEC	4,395	5,400	16,713	26,080	5.9	4.8	1.6
JAN	6,302	5,548	22,452	39,471	6.3	7.1	1.8
FEB	5,710	4,560	18,883	40,853	7.2	9.0	2.2
MAR	8,820	9,400	34,673	77,122	8.7	8.2	2.2
APR	6,717	6,421	26,755	51,549	7.7	8.0	1.9
MAY	5,090	5,236	20,464	17,022	3.3	3.3	0.8
JUN	6,592	7,021	28,596	42,387	6.4	6.0	1.5
JUL	4,820	6,523	23,380	14,614	3.0	2.2	0.6
AUG	2,802	1,824	9,403	5,636	2.0	3.1	0.6
SEP	4,019	3,799	14,095	11,059	2.8	2.9	0.8
FY'93	63,120	64,218	248,090	367,662	5.8	5.7	1.5

Table 2. Monthly composition of the Guam trolling catch during FY'93. Estimates include the Guam International Fishing Derby (GIFD). Weights are in kilograms (1 Kg = 2.2046 lbs).

MONTH	Mahimahi	Wahoo	Skipjack tuna	Yellowfin tuna	Blue marlin	other
OCT	875	2,458	7,400	2,335	572	960
NOV	3,579	11,623	6,452	4,569	784	260
DEC	7,557	6,080	3,117	8,658	0	668
JAN	32,632	1,475	2,672	2,810	0	150
FEB	34,012	1,875	2,702	979	1,016	267
MAR	57,897	9,614	5,310	3,095	0	1,203
APR	37,222	986	11,495	1,744	0	103
MAY	2,703	133	5,539	6,707	1,827	112
JUN	3,002	804	18,012	7,920	6,866	355
JUL	143	160	1,344	1,413	11,249	305
AUG	225	212	460	206	4,380	153
SEP	239	337	3,791	1,237	5,305	151
FY'93	179,817	35,757	68,294	41,674	32,000	4,688

Table 3. Estimated monthly bottomfishing participation, effort, and catch during FY'93. Weights are in kilograms (1 Kg = 2.2046 lbs).

MONTH	No. of Persons	No. of Boat hours	No. of Person hours	No. of Kilograms	Kg/ per- son	Kg/ boat- hour	Kg/ person- hour
OCT	384	381	1,137	1,050	2.7	2.8	0.9
NOV	338	657	1,205	1,235	3.7	1.9	1.0
DEC	248	374	1,130	191	0.8	0.5	0.2
JAN	687	823	2,572	1,186	1.7	1.4	0.5
FEB	410	126	657	32	0.1	0.3	0.0
MAR	734	550	1,617	1,437	2.0	2.6	0.9
APR	243	198	675	805	3.3	4.1	1.2
MAY	1,036	833	2,636	904	0.9	1.1	0.3
JUN	1,653	2,338	6,873	6,097	3.7	2.6	0.9
JUL	1,234	2,770	5,686	7,759	6.3	2.8	1.4
AUG	499	667	1,908	1,554	3.1	2.3	0.8
SEP	1,127	2,949	8,379	3,109	2.8	1.1	0.4
FY'93	8,592	12,665	34,475	25,360	3.0	2.0	0.7

Table 4. Estimated monthly offhscree spearfishing (with and without scuba) participation, effort, and catch during FY'93. Weights are in kilograms (1 Kg = 2.2046 lbs).

MONTH	No. of Persons	No. of Boat hours	No. of Person hours	No. of Kilograms	Kg/ per- son	Kg/ boat- hour	Kg/ person- hour
OCT	23	28	56	0	0.0	0.0	0.0
NOV	122	106	297	1,062	8.7	10.0	3.6
DEC	299	249	865	1,783	6.0	7.2	2.1
JAN	0	0	0	0			
FEB	278	244	677	1,254	4.5	5.1	1.9
MAR	444	435	1,031	2,298	5.2	5.3	2.2
APR	223	113	440	562	2.5	5.0	1.3
MAY	484	481	1,210	1,910	3.9	4.0	1.6
JUN	478	534	1,387	3,026	6.3	5.7	2.2
JUL	1,149	1,110	3,413	6,655	5.8	6.0	1.9
AUG	129	48	193	875	6.8	18.1	4.5
SEP	465	412	1,428	1,240	2.7	3.0	0.9
FY'93	4,094	3,760	10,999	20,664	5.0	5.5	1.9

APPENDIX 1

Guam International Fishing Derby

PERIOD COVERED: 16-18 July, 1993

INTRODUCTION

The seventeenth Guam International Fishing Derby (GIFD), sponsored by the Guam Visitors Bureau (GVB), was held on July 16, 17, and 18, 1993. Awards were presented to the anglers who landed the first, second, third, fourth, fifth, and sixth heaviest fishes of the following species: blue marlin (*Makaira mazara*), yellowfin tuna (*Thunnus albacares*), wahoo (*Acanthocybium solandri*) and mahimahi (*Coryphaena hippurus*). Records were kept in an "other species" category by the DAWR.

PROCEDURES

DAWR biologists were present at both check-out/check-in stations, the Agana Boat Basin and the Agat Marina. A log of all departing and returning boats was kept and as many returning boats as possible were intercepted and interviewed. All fish to be eligible for entry had to be weighed in at the Agana Boat Basin, so participation there was higher than at the Agat Marina.

Parameters of participation and effort were determined by using daily averages in place of missing data wherever possible. This was done for number of fishermen, number of lines fished, and "down time" when determining hours spent fishing. For these parameters, daily data was missing for approximately 5 to 31% of returning boats, depending on the parameter and day. The number of boat trips and boat hours was known since a log of all departing and returning boats was kept.

Determination of catches required a subjective appraisal of what species were likely to be present in non-intercepted boats. Average daily catch rates by species were assigned to non-intercepted boats in order to determine daily totals. Catches of non-intercepted boats were assumed to contain only non-derby species. The daily proportion of returning boats intercepted ranged from 70% to 94%.

RESULTS

Participation

One hundred and twenty-six boats made 344 fishing trips during the course of the derby. This was an all time high and a 16% increase in the number of participants over that of last year. There were an average of 2.9 anglers pulling an average of 4.3 lines per trip. The mean time spent on the water was 8.1 hours per boat trip, of which 7.7 hours were spent fishing.

Catch

A total of 2,676.5 kg of derby species were landed. This was the lowest total since 1983 (Tables 2, 3). The bulk (67%) of the catch consisted of blue marlin (1,817.5 kg). Including the by-catch of five species which accounted for 45% of the fishes but only 15% of the weight, 359 fish weighing 3,153.9 kg were caught. The bulk of the bycatch

consisted of skipjack tuna (342.7 kg) with the remainder consisting of 134.9 kg of barracuda, kawakawa, dogtooth tuna, and rainbow runner.

The mean catch rates were probably the lowest in derby history: 9.2 kg per boat per trip and 1.2 kg per boat-hour fished. Like the overall catch rate, the catch rates for each of the derby species were low. The catch rate for blue marlin was only 45% of that of last year's but greatly exceeded those for all other derby species (0.68 vs <0.24 kg/boat-hour fished).

Sixty-one blue marlin weighing 1,805.5 kg were landed during the 1993 GIFD. The mean weight of 69.4 kg was slightly larger than those of the last four derbies and the 162.6 kg winning fish was the largest in four years.

One hundred and three yellowfin tuna weighing 659.5 kg. were landed. The mean weight of 6.4 kg was the lowest since 1989, but the 57.9 kg winning fish was the largest since 1982.

Nineteen wahoo weighing 160.3 kg were landed with a mean weight of 8.4 kg. This was the lowest derby wahoo catch since 1986. However, the winning fish of 31.4 kg was highest in derby history.

Twelve mahimahi weighing 39.2 kg were landed. This low catch is typical of July. The 7.7 kg winning fish was the second smallest of the last 10 years.

Fishing areas

Useable locality data was obtained from 77% of the returning boat trips. This made it possible to compare catches and catch rates by area (Table 4). More than twice as many boats fished north of the Agana Boat Basin than south of it (215 vs 82 reported trips). About half the boats that fished to the north fished the northern banks and nearly two-thirds of the boats fishing to the south fished the southern banks. Although more fish were caught in the north, catch rates were higher in south. The pattern of higher overall catch rates in the south was consistent with five of the six preceding years.

ACKNOWLEDGEMENTS

The fisheries staff of the Division of Aquatic & Wildlife Resources (DAWR) wish to thank the competing anglers, the Guam Visitor's Bureau, Guam Fishermen's Cooperative, and members of the seventeenth GIFD derby committee for their cooperation and assistance in providing the information that made this report possible. This cooperation not only makes our job easier and more enjoyable, but insures a more accurate collection of data and better information for the fisherman.

Report prepared by Robert F. Myers

Table 1. Daily participation, effort and catch in the seventeenth annual Guam International Fishing Derby.

	DAY 1 JUL 16	DAY 2 JUL 17	DAY 3 JUL 18	DERBY TOTALS
Number of boats	103	110	107	126
Number of boat trips	109	119	116	344
Number of fishermen*	318	349	348	1015
Average number of men per boat	2.9	2.9	3.0	2.9
Number of lines fished**	475	506	488	1469
Average number of lines per boat	4.4	4.3	4.2	4.3
Boat hours	926.7	965.5	885.0	2,777.2
Fished hours	901.3	871.3	868.0	2,640.6
Average boat trip length	8.5	8.1	7.6	8.1
Average time spent fishing	8.3	7.3	7.5	7.7
Fisherman hours	2,604.1	2,552.9	2,631.8	7,788.8
Line hours†	3,654.2	3,703.0	3,920.7	1,1277.9
Number of fish landed	152	127	79	359
Catch landed (kg)††	1,550.8	896.9	706.3	3,153.9
Kg/boat	15.06	8.71	6.60	25.03
Kg/boat trip	14.23	8.23	6.09	9.17
Kg/boat hour	1.78	1.00	0.81	1.19
Kg/person hour	0.60	0.35	0.27	0.40
Kg/line hour	0.42	0.24	0.18	0.28

* Daily total assumes no turnover of participants for boats with multiple trips per day; derby total is given as 100% turnover.

** Artificial data based on the average number of lines per boat interviewed multiplied by the number of boats.

† Based on actual time spent fishing and overall average number of lines per boat.

†† Includes incidental catch of non-derby species.

Table 2. Daily catch composition for the seventeenth annual Guam International Fishing Derby.*

SPECIES	DAY 1 - JUL 16			DAY 2 - JUL 17			DAY 3 - JUL 18			DERBY TOTALS		
	NUMBER CAUGHT	TOTAL WT.	AVE WT.	NUMBER CAUGHT	TOTAL WT.	AVE WT.	NUMBER CAUGHT	TOTAL WT.	AVE WT.	NUMBER CAUGHT	TOTAL WT.	AVE WT.
Derby												
Blue marlin	13	978.9	75.3	8	463.8	58.0	5	362.8	72.6	26	1,805.5	69.4
Shortbill spearfish	1	12.0	12.0							1	12.0	12.0
Yellowfin tuna	52	321.2	6.2	27	145.9	5.4	24	192.4	8.0	103	659.5	6.4
Wahoo	8	67.2	8.4	8	63.1	7.9	3	29.9	10.0	19	160.3	8.4
Mahimahi	6	24.4	4.1	2	4.7	2.4	4	10.2	2.6	12	39.2	3.3
Non-derby												
Skipjack tuna	24	63.7	2.7	73	195.8	2.7	27	83.1	3.1	125	342.7	2.7
Kawakawa	1	1.9	1.9	4	5.1	1.3	4	7.1	1.8	9	14.2	1.6
Dogtooth tuna	1	3.6	3.6	-	-	-	-	-	-	1	3.6	3.6
Rainbow runner	37	60.7	1.6	4	6.5	1.6	9	11.0	1.2	50	78.2	1.6
Barracuda	8	17.2	2.2	1	11.9	11.9	3	9.7	3.2	12	38.9	3.2
TOTALS	152	1,150.8	10.2	127	896.9	7.1	79	706.3	8.9	359	3,153.9	8.8

* Figures for non-derby species of which more than one were known to have been caught are based on an expansion that accounts for returning vessels that were missed. Expanded numbers of fishes are rounded to the nearest whole number.

Table 3. Catch comparison for all Guam International or Marianas Fishing Derbies¹. Weights are expressed in kilograms (1 kg=2.2 046 lbs).

	1977	1978	1979	1980	1981	1982	1983	1984 ²	1985	1986	1987 ³	1988	1989	1990	1991	1992 ⁶	1993
BLUE MARLIN																	
no. caught	9	9	6	12	34	12	13	47	17	47	43	58	86	64	61	42	27
total weight	932.9	511.1	702.9	727.0	2,005.0	852.2	964.2	2,840.4	1,659.0	2,859.0	4,008.2	3,831.9	5,263.6	3,398.9	3,102.3	2,714.9	1,817.5
ave. weight	103.6	56.8	117.2	60.6	59.0	71.0	74.2	60.4	97.6	60.8	93.2	66.1	61.2	53.1	50.8	64.6	67.3
winning fish	191.8	75.3	237.2	138.8	145.1	132.0	199.1	215.4	177.8	173.7	188.2	155.3	182.2	133.8	111.1	152.4	162.6
YELLOWFIN TUNA																	
no. caught	18	11	34	50	109	205	100	59	137	71	116	161	81	81	102	99	103
total weight	239.9	254.9	637.2	307.9	1,156.0	2,376.9	1,105.7	388.8	1,058.0	405.9	858.5	848.5	385.2	546.3	1,129.1	891.2	659.5
ave. weight	13.3	23.2	18.7	6.2	10.6	11.6	11.1	6.6	7.7	5.7	7.4	5.3	4.8	6.8	7.9	9.0	6.4
winning fish	46.3	56.7	67.6	51.2	47.6	61.2	55.8	51.7	45.8	45.8	26.8	44.9	21.5	39.9	57.8	29.5	57.9
WAHOO																	
no. caught	7	9	11	12	60	33	36	46	98	16	31	72	59	34	40	38	19
total weight	90.7	102.0	116.1	161.0	542.9	263.9	359.6	466.2	921.5	136.5	314.3	567.4	588.1	249.7	316.7	322.0	160.3
ave. weight	13.0	11.4	10.5	13.4	9.0	8.0	10.0	10.1	9.4	8.5	10.1	7.8	10.0	7.3	7.9	8.5	8.4
winning fish	22.2	19.0	19.5	23.6	16.8	22.7	24.5	21.3	23.6	17.7	16.8	22.4	17.9	17.6	24.0	20.0	31.4
MAHIMAH																	
no. caught	2	4	5	3	1	14	33	0	14	7	3	5	7	25	11	23	12
total weight	13.6	26.3	52.6	39.5	0.9	63.5	195.0	0.0	76.6	61.7	39.9	12.2	36.9	121.6	107.8	131.6	39.2
ave. weight	6.8	6.6	10.5	13.1	0.8	4.6	5.9	0.0	5.5	8.8	13.4	2.4	5.3	4.9	9.8	5.7	3.3
winning fish	9.1	9.1	15.0	15.9	0.9	15.0	10.9	0.0	15.0	14.5	15.4	4.3	18.4	10.8	18.5	9.1	7.7
DERBY SPECIES																	
no. caught	36	33	56	77	177	291	182	152	266	141	193	296	233	205	214	202	161
total weight	1,277.6	894.3	1,508.4	1,235.4	3,704.8	3,556.9	2,624.5	3,695.2	2,716.1	3,463.5	5,220.9	5,260.0	6,273.8	4,316.6	4,655.9	4,059.6	2,676.5
most per boat											57	42	26				
TOTAL CATCH																	
no. caught	0.0	0.0	0.0	0.0	0.0	0.0	281	336	427	237	488	993	562	623	412	531	359
total weight							3,277.6	4,365.1	4,370.1	3,794.1	6,668.5	8,188.4	7,969.8	5,646.8	5,203.9	5,040.0	3,153.9

¹Based on returned catch reports for 1977 to 1983, but includes estimated bycatch and unreported catches for 1984 to present. Only the principal derby species are reported for 1977 to 1982.

²Based on known catches of principle derby species and estimated catches of non-derby species expanded for non-reporting boats.

³Figures for blue marlin and yellowfin tuna originally reported are in error. The corrected figures are given here.

⁴Includes 2 sailfish weighing a total of 56.4 kg in 1989; 1 sailfish in 1990 and 1992 weighing 29.9 and 34.5 kg, respectively; and 1 shortbill spearfish weighing 12.0 kg in 1993.

⁵Includes all tuna species.

⁶Third day of derby cancelled; all totals based on 2 days fishing.

Table 4. Effort, catch, and catch rates by area for the seventeenth annual GFD. Effort is based on the number of boat trips in which area fished was reported and includes all boats known to have fished within a given area. A small number of catches from unspecified areas are not included.

Area	Effort (number of boat trips)	Catch ¹		Wahoo		Mahimahi		Blue marlin		Catch rate (no. and kg/trip)		Mahimahi	
		Yellowfin tuna	kg	no.	kg	no.	kg	no.	kg	Yellowfin tuna	kg	Wahoo	kg
North	215	46	328.1	11	89.4	4.5	18.7	0.08	5.4	0.21	1.5	0.05	0.4
Guam ²	189	16.5	148.9	6	49.6	1.8	9.2	0.05	3.4	0.09	0.8	0.03	0.3
Banks	106	22.5	161.1	3	26.4	2.8	9.5	0.06	4.3	0.21	1.5	0.03	0.2
South	82	55	311.0	10	84.2	7.3	19.6	0.12	8.1	0.67	3.8	0.12	1.0
Guam ³	69	17	79.2	6	51.5	2.3	5.6	0.04	2.7	0.25	1.1	0.09	0.7
Banks	52	38	231.8	4	32.7	5.0	14.0	0.13	9.1	0.73	4.5	0.08	0.6
Total	266	101	639.1	21	173.6	11.8	38.3	0.10	6.8	0.38	2.4	0.08	0.7
													0.1

¹Catch from unspecified areas on trips in which the areas fished were indicated are divided equally among areas fished resulting in fractions for certain areas.

²Orote Pt. to Pati Pt.

³Orote Pt. to Inarajan.

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: F-1R-1
SUB-PROJECT NO.: F-1
STUDY NO.: 1
JOB NO.: 2

STUDY 1: Fisheries Participation, Effort, and Harvest Surveys (2430)

JOB TITLE: Inshore Fisheries Survey

PERIOD COVERED: October 1, 1992 to September 30, 1993

SUMMARY

Monthly inshore fisheries surveys were conducted along Guam's shoreline from October, 1992 to September, 1993. The total estimated inshore fisheries catch for this time period was 52.5 mt (metric tonnes), 82% of which were finfish (excluding mañâhak). Hook and line fishing was the most practiced method accounting for 53% of the total participation* or 26,175 participants. In terms of catch rate, drag netting was the most successful daytime and nighttime method, yielding approximately 13.7 kg/gear-hour (gh) with a harvest of 2.7 mt and approximately 3.9 kg/gh with a harvest of 0.2 mt respectively. Gill netting was the most successful method in terms of catch, yielding approximately 0.9 kg/gh and a harvest of 12.8 mt. The seasonal mañâhak fishery in surveyed areas accounted for approximately 12% of the total finfish harvest or 6.3 mt.

Aerial Survey

The aerial survey report is included in Appendix 1.

BACKGROUND

Effective management of Guam's inshore fishery resources requires accumulating data on the types of fishing methods used, fishing pressure, and annual catch. In order to identify trends in fishing participation, effort, and catch, the Division of Aquatics and Wildlife Resources (DAWR) has been monitoring marine fishing activities since the early 1960's. Over this period of time, survey and analysis methodologies have changed in response to fluctuations in budget and staff. In the last several years, however, field survey techniques have been expanded and refined, while estimates of Guam's recreational / subsistence fishing activities have come to be based on more reliable data analysis techniques.

OBJECTIVES

1. To establish baseline catch and effort data for reef fish species necessary to develop a fisheries management plan for Guam.

* All participation and effort statistics except total harvest exclude seasonal fisheries data.

2. To gather limited biological data that will add to a long-term historical data base on Guam's fish species, which can be used to identify fisheries that require more intense research for management purposes.

PROCEDURES

During FY93, day and night "inshore participation" surveys were conducted on four randomly selected days per month. These surveys entailed making visual observations of fishermen participation that included the reef zones and general locations that were fished within the more readily accessible portions of Guam's coastline (Fig. 1, locations 1-71). Based on data collected during nine non-consecutive years of aerial surveys conducted between FY63 and FY79, approximately 85% of Guam's inshore fishing activities is known to occur within this area. The starting location for each survey was selected at random and the "clockwise or counterclockwise" direction of driving was alternated between surveys. Observations were made while driving the route once without backtracking. These methods were applied for both day and night participation surveys.

During FY93, four "inshore-catch" survey days were selected per month. During these survey days, fishermen-intercept interviews were conducted to gather catch, effort, and species composition data for both day and night fishing. The day survey covered a six-hour interval (beginning at 0630 h) and the night survey covered a five-hour interval (beginning at 1900 h). Only one of three survey regions (Fig. 1) was selected for each "inshore-catch" day and fisheries data collection was restricted to that region. However, because of infrequently interviewed methods (i.e., surround net), representative samples were sometimes difficult to obtain. Therefore, if a particular fishing method was not observed within the selected survey area during the survey, one or both of the other two areas could be surveyed for that method.

Seasonal data on the bigeye scad (atulai) and the juveniles of fusiliers (achenchon), goatfish (ti'ao), jacks (i'e'), and rabbitfish (mañâhak), were acquired through actual participation and "inshore catch" surveys.

Because the coastal fishing participation and range has steadily increased over recent years, aerial surveys were reinstated around Guam during FY90 in order to update islandwide participation estimates. Aerial surveys for this reporting period were begun in October, 1991 and conducted twice monthly. The surveys were performed on regularly scheduled participation days (one weekday / weekend) and began on the hour, rotating through from 0800 h to 1200 h for each subsequent survey. Visual observations of the fishing methods, participants, gear units, and areas fished were recorded as done in the inshore participation survey. Other data collected during these flights include observations of marine mammals, turtles, sharks, offshore fishing activity, FAD (fish aggregation device) use, and other incidental information.

The FY93 inshore harvest estimates were calculated by a computer software package for Macintosh known as the 4th Dimension database program (4D). The 4D program utilizes formulae described in the FY83 report (Project FW-2R-20, Sub-Project F, Study F-1, Job 2)

RESULTS

During FY93, the estimated inshore harvest for day, night, and seasonal fishing around Guam was 52.5 mt. Finfish (excluding mañâhak) accounted for 82% of total harvest or 42.9 mt. The seasonal mañâhak harvest was estimated at 12% of the total finfish harvest or 6.3 mt. The total fish catch (finfish and non-finish, excluding mañâhak) resulted from

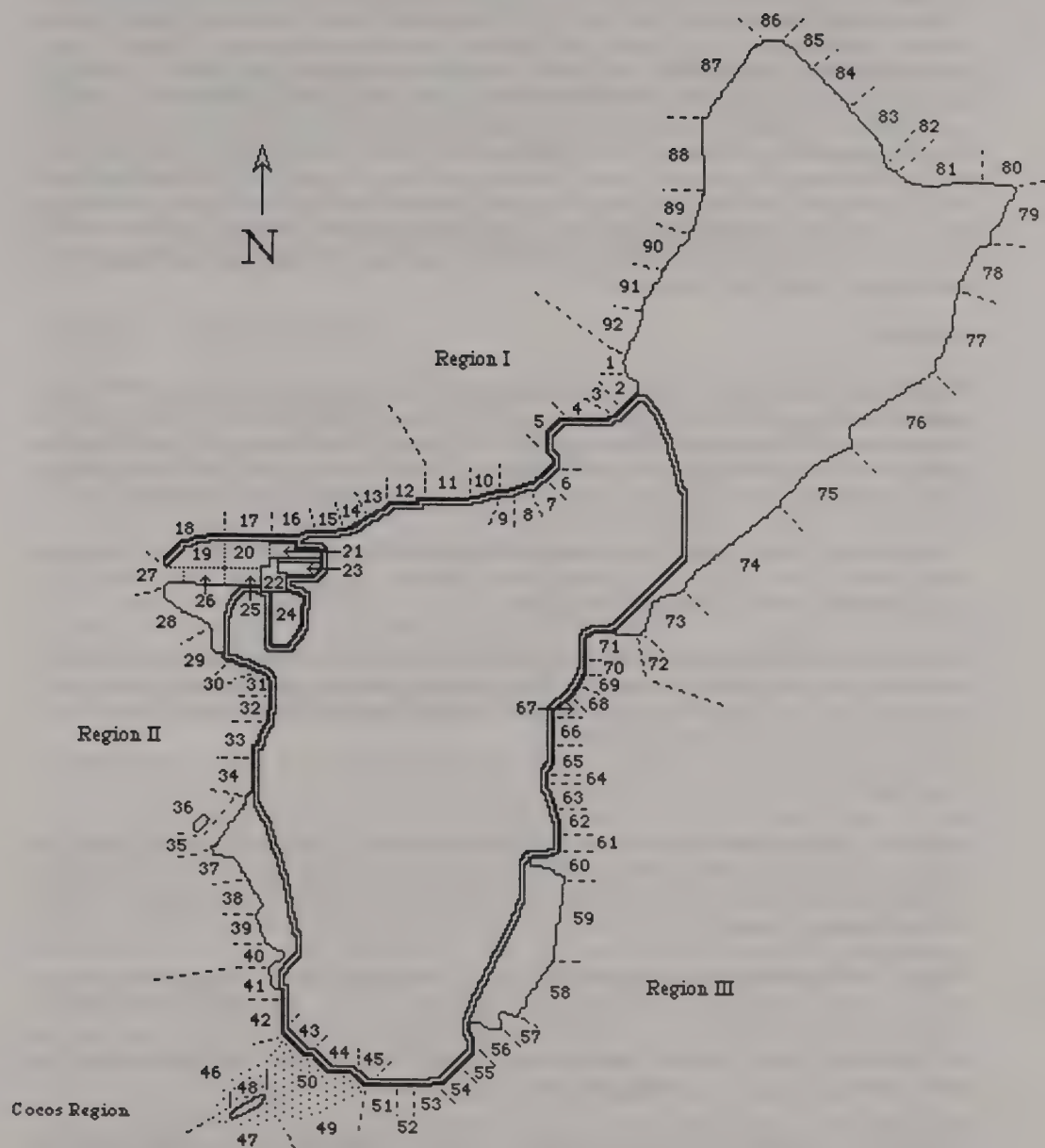


Figure 1. Inshore Fisheries "Participation Survey" Route and Location Codes.

a total effort of 180,391 person-hours (ph) and 159,999 gh. Overall, approximately 0.29 kg/gh of fish were harvested. Estimated participation, effort, and catch values for each fishing method are shown in Tables 1-3. The values in Table 1 are combined estimates of separate expansions of day, night, and seasonal catch data collections. Tables 2 and 3 present the participation, effort, and catch for day (Table 2) and night (Table 3) fishing for each method. Estimated catch composition for the top ten species and families of finfish harvested are shown in Tables 4-6. The listings in Table 4 are the top ten species and families caught for combined day and night catches. Tables 5 and 6 list the top ten species and families caught for day (Table 5) and night (Table 6) with all methods combined. Table 7 compares the top species and families harvested for day and night in FY89 and FY93. Table 8 lists the estimated total mañāhak harvest in selected areas for FY93. Tables 9-11 list the top species harvested by hook and line, gill net, and spearfishing with snorkel gear for day and night in FY93.

EFFORT

Hook and line fishing was the most practiced fishing method based on the total participation (combined day and night values), accounting for 26,175 persons or approximately 53% of the total participation. Cast netting was the second most practiced method overall accounting for 9,186 participants or 19% of the total participation, while gill netting followed in third with 7,876 participants or 16% of the total participation.

The rank order for day fishing participation placed hook and line first with 16,502 or 49% participants. Cast netting and gill netting placed second and third respectively with 9,082 or 27% and 4,416 or 13% of the participants.

Hook and line fishing remained the most practiced night method with 9,673 participants or 62% of night participation. The second most practiced method was gill netting with 3,461 participants or 22%, while spearfishing with snorkel gear followed in third with 2,155 participants or 14% of night participation.

CATCH

Gill netting yielded the largest overall finfish catch with 12.8 mt or 30% of the total fish harvest. Spearfishing with snorkel gear was second with 8.9 mt or 21%, while hook and line fishing was third with 6.6 mt or 15%, and surround netting was fourth with 5.4 mt or 13% of the total harvest.

The top three daytime methods accounted for approximately 65% of the total day finfish harvest and approximately 46% of the combined total harvest. Gill netting accounted for the most finfish with 8.7 mt or 29% of the day harvest and hook and lining was second with 5.5 mt or 18%. Surround netting was third with 5.4 mt or 18% and cast netting was fourth with 4.4 mt or 15% of the total day harvest.

The top three nighttime methods accounted for approximately 96% of the total night finfish harvest and approximately 29% of the combined total harvest. Spearfishing with snorkel gear accounted for the most finfish with 7.9 mt or 61% of the total night harvest and gill netting was second with 4.1 mt or 32%. Hook and line fishing was third with 1.1 mt or 8% and drag netting was fourth with 0.2 mt or 2% of the total night harvest.

CATCH PER UNIT EFFORT (CPUE)

The CPUE values for the FY93 expanded daytime and nighttime harvests are included in Tables 1-3.

Drag netting had the highest daytime CPUE of 13.65 kg/gh for weekend day fishing. Surround netting followed in second with 8.61 kg/gh for weekend day fishing while spearfishing with snorkel gear was third with 2.05 kg/gh for weekday fishing.

Drag netting also had the highest nighttime CPUE of 3.90 kg/gh for weekend night fishing. Spearfishing with snorkel gear followed in second with 1.93 kg/gh for weekday night fishing and cast netting was third with 1.25 kg/gh for weekday night fishing. The information concerning effort and harvest for methods not discussed are included in the summary Tables 1-3.

Other nearshore fisheries harvests on Guam, including spearfishing with snorkel and scuba gear by boat, are recorded in the FY93 Offshore Fisheries Report (Study F-1, Job 1).

SPECIES COMPOSITION

The species composition for the FY93 expanded harvest for day, night, and combined efforts are presented in Tables 4, 5, and 6. The top day-caught species (excluding mañāhak) was the goatfish, *Mulloides flavolineatus*, which accounted for approximately 3.7 mt or 12% of the day total with 55% and 23% of the daytime drag net and gill net harvest respectively. The top night caught species was *Myripristis berndti*, which accounted for approximately 1.6 mt or 12% of the night total with 19% and 5% of the nighttime spearfishing with snorkel gear and hook and line harvest respectively.

Spearfishing with scuba did not account for a significant amount of fish caught during the survey period, despite the high catch rate using this method. The main reason for this occurrence is that a greater percentage of scuba spearfishermen are difficult to encounter during a survey and many of them go to the outer reefs, e.g., Double Reef or outer Cocos Lagoon from boats than by shore (Study F-1, Job 1).

A comparison was made between the combined day and night catch composition for the top species and families of finfish harvested in FY89 and FY93 (Table 7). Harvests of *Kyphosus cinerascens*, *Naso unicornis*, *Lutjanus fulvus*, *Mulloides flavolineatus*, *Gerres argyreus*, *Siganus spinus*, *S. argenteus*, and *Valamugil engeli*, were reduced by 59%, 59%, 55%, 50%, 48%, 37%, 33%, and 14% respectively, while *Acanthurus triostegus* and *Crenimugil crenilabis*, increased by 22% and 13% respectively in FY93. Family harvests of Kyphosidae, Gerreidae, Siganidae, Lutjanidae, Mullidae, Acanthuridae, and Mugilidae, were reduced by 58%, 48%, 33%, 29%, 36%, 16%, and 9% respectively, while Lethrinidae, Holocentridae, and Carangidae, and increased by 59%, 49%, and 8% respectively in FY93.

The seasonal catch of certain juvenile fishes is widely anticipated by local fishermen. The catches of ti'ao ($\leq 100\text{mm}$) and i'e' ($\leq 200\text{mm}$) are usually well represented within the expansion estimates (Tables 4-6). During FY93, pulses of recruiting i'e' occurred from July - September, 1993, while ti'ao catches occurred from December 1992 - January 1993 and from June - September 1993. Ti'ao (*Mulloides flavolineatus* and *M. vanicolensis*) ranked 6th for day harvest with 1.1 mt (Table 5). The Caranx i'e' harvest was not significant enough to make the top ten list for daytime and nighttime harvests (Tables 4-6).

FY93 marked an exceptional year for mañāhak (ha'tang or *Siganus spinus* and lessso' or *S. argenteus*). The estimated mañāhak catch in East Agana Bay for 1993 was 5.9 mt or 12% in the following locations (Fig. 1): 1, 12, 13, and 43 for 1993 was 0.3 mt or <1% of

the total annual harvest. The harvest estimates for these fish were determined independently from the 4D program due to the sporadic nature of this fishery.

The atulai (*Selar crumenophthalmus*) seasonal catch was minimal with a daytime harvest of 6.2 kg by hook and line for FY93. The achenchon (*Pterocaesio* spp.) run did not occur in FY93.

In addition to finfish, a number of other marine invertebrates were harvested from Guam's reefs. An estimated 2.1 mt (4% of the total annual and 62% of the total invertebrate harvests) of octopus were caught island-wide during FY93. Daytime octopus harvests accounted for 1.7 mt (63% by hooks and gaffs, 32% by spearfishing with snorkel gear, 4% by gill nets, and <1% by spearfishing with scuba gear), while nighttime harvests accounted for 0.4 mt (100% by spearfishing with snorkel gear) in FY93.

The second most caught invertebrate was the spiny lobster, *Panulirus penicillatus*, with an estimated 0.9 mt (2% of the total annual and 27% of the total invertebrate harvests) of the island-wide catch in FY93. Daytime spiny lobster harvests accounted for 0.7 mt (80% by spearfishing with snorkel gear and 20% by gill nets) and nighttime harvests accounted for 0.2 mt (100% by spearfishing with snorkel gear) in FY93. Spearfishing with scuba and snorkel gear accounts for a significant amount of spiny lobster, slipper lobster, and miscellaneous decapods, e.g., *Carpilius maculatus*, harvested at night (based on personal observations by R.F. Meyers, Study F-1, Job 1), but these species were not significantly represented in the inshore survey estimates due to the rarity of snorkel and scuba spearfishing interviews.

Other methods, e.g., gleaning and hand netting, produced an estimated 1.9 mt or 4% of finfish and invertebrates, e.g. Engraulididae and Brachyura, with a catch rate of 0.1 kg/ph of fishing effort.

RECOMMENDATION

The establishment of the 4D program has greatly reduced the time needed to compile and analyze Guam's inshore survey data. Because of this, more effort has been spent to continually upgrade our data collection procedures to ensure statistical reliability.

Initial aerial observations show that 87.2% of the participants and 87.3% of the gear-units are being surveyed on the shore participation route when compared with the islandwide count. Even though this falls within the estimated 85% from previous aerial surveys (FY63-79), it is recommended that the aerial surveys be continued. The sampling technique has improved since the initiation of the aerial surveys and with further data, an improved quantitative analysis can be done for islandwide inshore fishing effort. Comparisons with aerial participation data should be statistically compared to data obtained during the regular inshore participation in order to update the inshore expansion confidence.

Since the inshore fisheries survey provides information important for management and planning, it is recommended that this job be continued. Due to the inadequacies of the "inshore-catch" survey window, certain methods were not representative of the actual participation and is reflected in the following catch confidence limits for daytime: surround net = $\pm 60.2\%$ and hooks and gaffs = $\pm 46.8\%$; and nighttime: cast net = $\pm 73.2\%$ (methods not listed had confidence limits less than or equal to $\pm 32.3\%$). Methods rarely encountered ($\pm 100\%$) during the day included: surround net, scuba spear, and drag net; and night: surround net, scuba spear, hooks and gaffs, drag net, and other methods.

The FY93 mañāhak seasonal catch was marginal in comparison with harvests over the last five years. The island-wide harvest estimate would have been possible if the catch interviews were expanded to a greater part of the island.

In addition, the results obtained in the FY93 report can be implemented in the identification and management of fish that are steadily decreasing in the overall harvest estimates.

Report prepared by: Todd J. Pitlik
Project Cost: \$81,000

Table 1. Combined estimated inshore participation, effort, and total harvest for all methods during the day and night in FY93.

METHOD	Persons	Gears	Trips	Per-Hrs	Gear-Hrs	Catch	Finfish	Inverts	CPUE**
Hook & Line	26,175	26,383	12,793	105,458	106,172	6,562	6,562	0	0.14 wd
Cast Net	9,186	7,956	7,135	25,684	22,250	4,544	4,544	0	1.25 wn
Gill Net	7,876	3,943	3,361	34,512	17,465	13,019	12,780	239	0.8; wed
Surround Net	450	209	209	1,349	627	5,402	5,402	0	8.61 wed
Spear Snorkel	3,405	3,330	1,671	7,699	7,519	10,632	8,886	1,746	2.05 wd
Spear Scuba	118	89	35	163	118	98	84	14	1.36 wed
Drag Net	644	202	202	1,218	384	2,963	2,936	27	13.65 wed
Hooks & Gaffs	1,153	1,674	414	2,764	3,920	1,127	45	1,082	0.47 wed
Other*	471	471	191	1,543	1,543	1,876	1,652	224	1.74 wed
TOTAL	49,477	44,256	26,011	180,391	159,999	46,223	42,891	3,332	0.29

*Other methods typically includes: gleaning, hand nets, traps, and spears.

**CPUE (kg/gh) summary includes either the greatest weekday (wd) or weeknight (wn) or weekend day (wed), weekend night (wen) values listed in Tables 2 and 3. The greatest CPUE value for hook and line was region 3.

Table 2. Estimated inshore participation, effort, and total harvest for all methods during the day in FY93

METHOD	Persons	Gears	Trips	Per-Hrs	Gear-Hrs	Catch	Finfish	Inverts	CPUE**
Hook & Line	16,502	16,876	9,370	64,820	66,220	5,493	5,493	0	0.14 wd
Cast Net	9,082	7,871	7,051	25,434	22,061	4,357	4,357	0	0.24 wed
Gill Net	4,416	2,501	2,113	20,414	11,588	8,914	8,675	239	0.87 wed
Surround Net	450	209	209	1,349	627	5,402	5,402	0	8.61 wed
Spear Snorkel	1,250	1,193	808	3,262	3,112	2,728	1,623	1,105	2.05 wd
Spear Scuba	10	10	10	10	10	14	0	14	1.36 wed
Drag Net	533	167	167	986	309	2,716	2,716	0	13.65 wed
Hooks & Gaffs	1,153	1,674	414	2,764	3,920	1,127	45	1,082	0.47 wed
Other*	410	410	150	1,309	1,309	1,753	1,604	149	1.74 wed
TOTAL	33,805	30,911	20,292	120,348	109,156	32,504	29,915	2,589	0.39

*Other methods typically includes: gleaning, hand nets, traps, and spears.

**CPUE (kg/gh) summary includes either the greatest weekday (wd) or weekend day (wed) values. The greatest CPUE value for hook and line was region 3.

Table 3. Estimated inshore participation, effort, and total harvest for all methods during the night in FY93.

METHOD	Persons	Gears	Trips	Per-Hrs	Gear-Hrs	Catch	Finfish	Inverts	CPUE**
Hook & Line	9,673	9,506	3,423	40,638	39,952	1,070	1,070	0	0.04 wen
Cast Net	103	85	85	250	189	187	187	0	1.25 wn
Gill Net	3,461	1,442	1,248	14,099	5,878	4,105	4,105	0	0.72 wen
Surround Net	0	0	0	0	0	0	0	0	0.0
Spear Snorkel	2,155	2,137	863	4,437	4,407	7,904	7,263	641	1.93 wn
Spear Scuba	108	79	24	153	108	84	84	0	0.78 wn
Drag Net	111	35	35	232	75	248	221	27	3.90 wen
Hooks & Gaffs	0	0	0	0	0	0	0	0	0.0
Other*	61	61	41	234	234	123	48	75	0.52 wn
TOTAL	15,672	13,345	5,718	60,043	50,843	13,721	12,978	743	0.27

*Other methods typically includes: gleaning, hand nets, traps, and spears.

**CPUE (kg/gh) summary includes either the greatest weeknight (wn) or weekend night (wen) values. The greatest CPUE value for hook and line was region 3.

Table 4. FY93 combined day and night catch composition for the top ten species and families of finfish harvested. *Mulloides flavolineatus* and *Siganus spinus*, are listed separately from the juvenile ti'ao ($\leq 100\text{mm}$) and mañāhak size class. Harvest percentages were derived from the day and night finfish catch (42,891 kg).

SPECIES	Harvest		FAMILY	Harvest	
	kg	%		kg	%
<i>Mulloides flavolineatus</i>	4,491.07	10.47	Acanthuridae	7,278.53	16.97
<i>Acanthurus triostegus</i>	2,397.75	5.59	Mullidae	6,701.99	15.63
<i>Siganus spinus</i>	2,247.60	5.24	Lethrinidae	4,514.94	10.53
<i>Lethrinus xanthurus</i>	2,155.75	5.03	Mugilidae	3,850.98	8.98
<i>Myripristis berndti</i>	1,979.72	4.62	Siganidae	3,355.27	7.82
<i>Naso unicornis</i>	1,967.35	4.59	Holocentridae	2,750.63	6.41
<i>Crenimugil crenilabis</i>	1,805.75	4.21	Carangidae	2,180.05	5.08
<i>Kyphosus cinerascens</i>	1,522.28	3.55	Scaridae	1,718.70	4.01
<i>Lethrinus obsoletus</i>	1,290.65	3.01	Kyphosidae	1,549.57	3.61
<i>Naso lituratus</i>	1,228.31	2.86	Lutjanidae	1,523.03	3.55
TOTAL ANNUAL COMBINED CATCH	21,086.23	59.97		35,423.69	59.97

Table 5. FY93 day catch composition for the top ten species and families of finfish harvested. *Mulloides flavolineatus* and *Siganus spinus*, are listed separately from the juvenile ti'ao ($\leq 100\text{mm}$) and mañāhak size class. Finfish harvest percentages were derived from the total daytime catch (29,915 kg).

SPECIES	Harvest		FAMILY	Harvest	
	kg	%		kg	%
<i>Mulloides flavolineatus</i>	3,685.43	12.32	Mullidae	5,551.37	18.56
<i>Lethrinus xanthurus</i>	2,147.04	7.18	Acanthuridae	4,553.40	15.22
<i>Acanthurus triostegus</i>	2,120.37	7.09	Lethrinidae	3,018.91	10.09
<i>Siganus spinus</i>	1,939.72	6.48	Siganidae	2,882.09	9.63
<i>Naso unicornis</i>	1,355.00	4.53	Mugilidae	2,150.64	7.19
<i>Mulloides ti'ao</i>	1,099.26	3.67	Carangidae	1,921.20	6.42
<i>Kyphosus cinerascens</i>	1,052.83	3.52	Engraulididae	1,442.81	4.82
<i>Encrasicholina punctifer</i>	1,048.73	3.51	Scaridae	1,274.28	4.26
<i>Valamugil engeli</i>	979.70	3.27	Kyphosidae	1,080.12	3.61
<i>Siganus argenteus</i>	789.69	2.64	Lutjanidae	1,048.59	3.51
TOTAL ANNUAL COMBINED CATCH	16,217.77	54.21		24,923.41	83.31

Table 6. FY93 night catch composition for the top ten species and families of finfish harvested. *Mulloides flavolineatus* and Siganidae, are listed separately from the juvenile ti'ao ($\leq 100\text{mm}$) and mañâhak size class. Finfish harvest percentages were derived from the total night catch (12,978 kg).

SPECIES	Harvest		FAMILY	Harvest	
	kg	%		kg	%
<i>Myripristis berndti</i>	1,567.91	12.08	Acanthuridae	2,725.13	21.00
<i>Crenimugil crenilabis</i>	1,170.04	9.02	Holocentridae	1,931.98	14.89
<i>Naso lituratus</i>	999.43	7.70	Mugilidae	1,700.34	13.10
<i>Lethrinus obsoletus</i>	823.37	6.34	Lethrinidae	1,496.03	11.53
<i>Mulloides flavolineatus</i>	805.64	6.21	Mullidae	1,150.62	8.87
<i>Acanthurus lineatus</i>	646.78	4.98	Lutjanidae	474.44	3.66
<i>Naso unicornis</i>	612.35	4.72	Siganidae	473.18	3.65
<i>Kyphosus cinerascens</i>	469.45	3.62	Gerreidae	470.24	3.62
<i>Gerres argyreus</i>	470.24	3.62	Kyphosidae	469.45	3.62
<i>Lethrinus harak</i>	439.40	3.39	Scaridae	444.42	3.42
TOTAL ANNUAL COMBINED CATCH	8,004.61	61.68		11,335.83	87.35

Table 7. Comparison of the combined day and night catch composition for the top species and families of finfish harvested in FY89 and FY93. Juvenile *Caranx ignobilis*, *C. melampygous*, *C. papuensis*, and *C. sexfasciatus* (i'e' $\leq 200\text{mm}$), *Mulloides flavolineatus* (ti'ao $\leq 100\text{mm}$), and *Siganus spinus* (mañâhak), are listed separately from the intermediate to adult size classes.

SPECIES	Harvest (kg)			FAMILY	Harvest (kg)		
	FY89	FY93	% Δ		FY89	FY93	% Δ
<i>Mulloides flavolineatus</i>	8,929.70	4,491.07	↓ 50	Mullidae	10,414.65	6,701.99	↓ 36
<i>Naso unicornis</i>	4,772.52	1,967.35	↓ 59	Acanthuridae	8,702.77	7,278.53	↓ 16
<i>Siganus spinus</i>	3,541.69	2,247.60	↓ 37	Siganidae	4,973.63	3,355.27	↓ 33
<i>Kyphosus cinerascens</i>	3,697.93	1,522.28	↓ 59	Mugilidae	4,225.90	3,850.98	↓ 9
<i>Gerres argyreus</i>	2,357.71	1,215.68	↓ 48	Kyphosidae	3,697.93	1,549.57	↓ 58
<i>Acanthurus triostegus</i>	1,874.71	2,397.75	22 ↑	Lutjanidae	2,143.56	1,523.03	↓ 29
<i>Crenimugil crenilabis</i>	1,563.33	1,805.75	13 ↑	Gerreidae	2,357.71	1,215.68	↓ 48
<i>Siganus argenteus</i>	1,431.94	954.99	↓ 33	Carangidae	2,015.58	2,180.05	8 ↑
<i>Lutjanus fulvus</i>	1,371.79	613.73	↓ 55	Lethrinidae	1,853.19	4,514.94	59 ↑
<i>Valamugil engeli</i>	1,340.56	1,158.56	↓ 14	Holocentridae	1,397.36	2,750.63	49 ↑
TOTAL ANNUAL COMBINED CATCH	30,881.88	18,374.76	↓ 41		41,782.28	34,920.67	↓ 16

% Δ reduction (↓) or % Δ increase (↑) of species and family totals (kg) from FY89-93.

Table 8. FY93 mañâhak harvest during April. Catch data (kg) was obtained from the following locations:
East Agana Bay, Asan, and Merizo, .

METHOD	Persons	Gears	Trips	Per-Hrs	Gear-Hrs	Catch	CPUE*
Cast Net	155.0	110.0	74.0	1,093.7	784.5	5,853.8	7.46
Surround Net	27.0	11.0	8.0	196.0	77.0	409.8	5.32
TOTAL	182.0	121.0	82.0	1,289.7	861.5	6,263.6	7.27

*CPUE summary is listed in kg/gh.

Table 9. FY93 day and night catch composition for the top ten species of finfish harvested by hook and line method. Juvenile *Caranx ignobilis*, *C. melampygous*, *C. papuensis*, and *C. sexfasciatus* (i'e' ≤ 200mm), are listed separately from the intermediate to adult size classes. Finfish harvest percentages were derived from the total day (5,493 kg) and night (1,070 kg) hook and line catch.

DAY SPECIES	Harvest		NIGHT SPECIES	Harvest	
	kg	%		kg	%
<i>Kyphosus cinerascens</i>	782.25	14.24	<i>Lethrinus obsoletus</i>	137.39	12.84
<i>Naso unicornis</i>	618.58	11.26	<i>Epinephelus merra</i>	104.61	9.78
<i>Caranx melampygous</i>	563.15	10.25	<i>Lethrinus harak</i>	91.86	8.59
<i>Caranx i'e'</i>	476.65	8.68	<i>Lutjanus monostigmus</i>	79.19	7.40
<i>Lutjanus monostigmus</i>	291.69	5.31	<i>Myripristis berndti</i>	53.89	5.04
<i>Epinephelus merra</i>	287.30	5.23	<i>Lutjanus fulvus</i>	53.45	5.00
<i>Lethrinus obsoletus</i>	257.82	4.69	<i>Carangoides orthogrammus</i>	51.47	4.81
<i>Caranx ignobilis</i>	211.18	3.84	<i>Sargocentron spiniferum</i>	45.93	4.29
<i>Lethrinus harak</i>	161.90	2.95	<i>Sphyræna forsteri</i>	36.43	3.40
<i>Lutjanus fulvus</i>	161.29	2.94	<i>Scolopsis lineatus</i>	34.96	3.27
Total Top Ten Hook & Line Catch	3,811.81	69.39		689.18	64.41
Total Combined Hook & Line Catch	4,500.99	68.58			

Table 10. FY93 day and night catch composition for the top ten species of finfish harvested by gill net method. *Mulloides flavolineatus* and *Siganus spinus*, are listed separately from the juvenile ti'ao ($\leq 100\text{mm}$) and mañâhak size class. Finfish harvest percentages were derived from the total day (8,675 kg) and night (4,105 kg) gillnet catch.

DAY SPECIES	Harvest		NIGHT SPECIES	Harvest	
	kg	%		kg	%
<i>Mulloides flavolineatus</i>	2,021.92	23.31	<i>Crenimugil crenilabis</i>	1,162.06	28.31
<i>Acanthurus triostegus</i>	831.90	9.59	<i>Mulloides flavolineatus</i>	653.24	15.91
<i>Gerres argyreus</i>	600.05	6.92	<i>Gerres argyreus</i>	463.64	11.29
<i>Naso unicornis</i>	476.42	5.49	<i>Kyphosus cinerascens</i>	379.15	9.24
<i>Myripristis berndti</i>	390.17	4.50	<i>Lethrinus obsoletus</i>	154.48	3.76
<i>Lutjanus fulvus</i>	338.18	3.90	<i>Siganus argenteus</i>	153.42	3.74
<i>Scarus sordidus</i>	304.70	3.51	<i>Liza vaigiensis</i>	132.26	3.22
<i>Scarus schlegeli</i>	296.27	3.42	<i>Valamugil engeli</i>	123.26	3.00
<i>Crenimugil crenilabis</i>	295.88	3.41	<i>Lutjanus monostigmus</i>	120.88	2.94
<i>Siganus spinus</i>	259.43	2.99	<i>Scolopsis lineatus</i>	73.53	1.79
Total Top Ten Gill Net Catch	5,814.92	67.03		3,415.92	83.21
Total Combined Gill Net Catch	9,230.84	72.23			

Table 11. FY93 day and night catch composition for the top ten species of finfish harvested by spear snorkel method. Finfish harvest percentages were derived from the total day (1,623 kg) and night (7,263 kg) spear snorkel catch.

DAY SPECIES	Harvest		NIGHT SPECIES	Harvest	
	kg	%		kg	%
<i>Acanthurus lineatus</i>	432.71	26.66	<i>Myripristis berndti</i>	1,502.70	20.69
<i>Siganus guttatus</i>	152.68	9.41	<i>Naso lituratus</i>	999.43	13.76
<i>Acanthurus guttatus</i>	148.36	9.14	<i>Acanthurus lineatus</i>	646.78	8.91
<i>Liza vaigiensis</i>	115.35	7.11	<i>Naso unicornis</i>	612.35	8.43
<i>Scarus schlegeli</i>	92.72	5.71	<i>Lethrinus obsoletus</i>	531.50	7.32
<i>Epibulus insidiator</i>	83.45	5.14	<i>Lethrinus harak</i>	329.29	4.53
<i>Siganus spinus</i>	82.21	5.07	<i>Acanthurus triostegus</i>	258.50	3.56
<i>Epinephelus merra</i>	69.85	4.30	<i>Siganus spinus</i>	245.49	3.38
<i>Scarus sordidus</i>	68.00	4.19	<i>Liza vaigiensis</i>	180.60	2.49
<i>Parupeneus bifasciatus</i>	34.55	2.13	<i>Sargocentron spiniferum</i>	171.57	2.36
Total Top Ten Spear Snorkel Catch	1,279.88	78.86		5,478.21	75.43
Total Combined Spear Snorkel Catch	6,758.09	73.79			

APPENDIX 1

INSHORE AERIAL SURVEY

PERIOD COVERED: October 1, 1992 to September 30, 1993

SUMMARY

A total of 15 "inshore aerial" surveys were conducted in FY93 for a total of 332 persons and 267 gear units. Hook and line was the most frequently encountered method with 162 persons and 157 gear units. A ratio of participants / method observed in areas outside the inshore participation route to the total number for all methods surveyed during the "inshore aerial" were calculated as variables (P_2 values) for the inshore expansion. The values ranged from 57% for weekday hooks and gaffs fishing to 100% for rare and night-practiced methods, e.g., surround net, SCUBA spearfishing, hooks and gaffs, drag net, and other methods.

Incidental biological sightings resulted in a total of 156 turtles, 248 dolphins, 36 sharks, 1 eagle ray, 15 stingrays, and 5 manta rays for FY93.

BACKGROUND

Inshore fishing surveys have been conducted by the Division of Aquatics and Wildlife Resources (DAWR) since the early 1960's to monitor and collect a long-term database on the total fishing effort and catch from Guam's reefs. The "inshore-catch" and "inshore-participation" surveys were developed to collect catch and effort data in nearshore areas easily accessible by motor vehicle. In addition, the "inshore-aerial" survey was established in the early 60's and reinstated in FY90 to survey effort in areas that could not be easily accessed by a vehicle.

PROCEDURES

"Inshore-aerial" surveys were conducted twice monthly on regularly scheduled participation days (one weekday / weekend). Start times are moved up in one hour intervals for each subsequent survey (0800-1200h), then repeated after reaching 1200h. Visual observations of areas not covered in the "inshore-participation" survey (Fig. 1 locations: 22, 27, 28, 35-39, 44-50, 58, 59, 70, and 73-92) included fishing effort data. The first scheduled weekday and weekend participation survey dates of each month were selected to allow rescheduling in the event of poor weather conditions.

Each survey started in area 11 and proceeded in a clockwise direction all the way around the island to area 12 (Fig. 1). The seaward flight distance from the reef margin was 200-300m with an altitude of 170-200m. The aerial itinerary also included a semi-circular flight pattern within Cocos Lagoon and Apra Harbor. In addition, the pilot was instructed to circle over reef flat areas when it was difficult to observe or determine activity.

The aerial survey observations were sorted by method and type day (weekday / weekend). A ratio of the persons / method observed in areas outside the inshore participation route were compared to the total number of persons / method observations for the island for each type day. The resultant P_2 values provided variables (%) that could be used to expand inshore participation values to island-wide participation values.

Other biological data collected, included incidental observations of marine mammals, turtles, sharks, and rays at or near the surface of various reef zones, e.g., Pati Point and the fore reef slope, along the aerial survey route.

The FY93 inshore harvest estimates were statistically expanded by a computer software package for Macintosh known as the 4th Dimension database program (4D). The 4D program utilizes formulae described in the FY83 report (Project FW-2R-20, Sub-Project F, Study F-1, Job 2) to compile and expand inshore survey data for the fiscal year.

RESULTS

The most frequently encountered methods included hook and line, cast net, gill net, surround net, snorkel spear, and other methods, while hooks and gaffs, SCUBA spear, and drag net methods were less common. Ratio frequencies were highest (100%) for the least common methods, which were due to the rarity of their use during the day, e.g., SCUBA spear and drag net are primarily night methods. Hook and line, cast net, gill net, surround net, snorkel spear, SCUBA spear, hooks and gaffs, and other methods (weekday and weekend days respectively) had P_2 values (Table 1) listed as percentages: (93 / 96), (63 / 74), (92 / 85), (100 / 100), (82 / 64), (100 / 100), (57 / 100), and (100 / 100), respectively for FY93.

Cancellations due to poor weather conditions, was a problem in FY93. Nine cancellations (38%) occurred on the following weekday (WD) and weekend (WE) survey dates: WD (1/29/93, 2/23/93, 8/25/93, and 9/17/93); and WE (11/29/92, 3/14/93, 6/13/93, 8/21/93, and 9/26/93).

The greatest number of people fishing in participation areas during the aerial survey used hook and line on weekdays and weekends for a total of 107 and 72 persons and gear-units respectively, while hook and line was also the most frequently used method in aerial areas for a total of 24 and 20 persons and gear units respectively for FY93 (Table 2).

Dolphins topped the list of the most frequently sighted marine animals during the aerial surveys with 248 sightings. The greatest monthly total of 60 dolphin sightings occurred in July (Table 3). Turtles, sharks, and stingray sightings ranked 2nd, 3rd, and 4th, respectively with annual totals (Table 3). The greatest monthly total of turtles were sighted in May with 32, sharks in July with 9, and stingrays in October with 5. In addition, 5 manta rays and 1 eagle ray were sighted in FY93 (Table 3).

Report prepared by: Todd J. Pitlik
Flight Cost: \$9,500

Table 1. P_2 values from aerial surveys in FY93. Ratios originated from method sightings within aerial locations : participation locations (Fig. 2). Methods are listed as follows: Hook and Line (HL), Cast Net (CN), Gill Net (GN), Surround Net (SN), Spear Snorkel (SpSn), Spear SCUBA (SpSc), Hooks and Gaffs (HG), Drag Net (DN), and Other Methods (OM).

Ratios	HL	CN	GN	SN	SpSn	SpSc	HG	DN	OM
Weekday	4/56	7/12	1/12	0/5	2/9	0/0	3/4	0/0	1/0
Weekend	4/98	7/20	6/35	0/23	8/14	0/0	0/0	0/0	0/0
WD Ratio	4/60	7/19	1/13	0/5	2/11	0/0	3/7	0/0	1/1
WE Ratio	4/102	7/27	6/41	0/23	8/22	0/0	0/0	0/0	0/0
WD P_2	93	63	92	100	82	100	57	100	100
WE P_2	96	74	85	100	64	100	100	100	100

Table 2. Total number of people and gear units observed during the aerial surveys in FY93. Abbreviations are listed for the following day types: WD (weekdays) and WE (weekends). Method abbreviations are listed in Table 1.

Methods	Within Par Route				Outside Par Route			
	Persons		Gears		Persons		Gears	
	WD	WE	WD	WE	WD	WE	WD	WE
HL	56	98	54	97	4	4	2	4
CN	12	20	7	20	7	7	5	6
GN	12	35	7	18	1	6	1	2
SN	5	23	1	3	0	0	0	0
SpSn	9	14	7	14	2	8	2	8
SpSc	0	1	0	1	0	0	0	0
HG	4	0	4	0	3	0	3	0
OM	0	0	0	0	1	0	1	0
Total	98	191	80	153	18	25	14	20

Table 3. Number of turtle, dolphin, shark, and ray sightings by aerial surveys around Guam in FY93.

Month	Turtle	Dolphin	Shark	Eagle Ray	Sting Ray	Manta Ray
Oct	16	50	3	0	5	1
Nov	4	0	0	0	0	2
Dec	16	40	4	0	1	0
Jan	8	6	1	0	1	0
Feb	2	0	4	0	4	0
Mar	12	20	3	0	0	0
Apr	18	50	1	0	0	0
May	32	2	7	0	1	0
June	18	20	4	0	2	2
July	30	60	9	1	1	0
Aug	0	0	0	0	0	0
Sep	0	0	0	0	0	0
Total	156	248	36	1	15	5

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: F-1R-1
SUB-PROJECT NO.: F-1
STUDY NO.: 2
JOB NO.: 1

JOB TITLE: Fisheries Data Processing. (2430)

PERIOD COVERED: October 1, 1992 to September 30, 1993

SUMMARY

During FY'93 the data processing project coordinator resigned. Present data files are incomplete and will be entered once new staff have been obtained.

BACKGROUND

Guam's Division of Aquatic and Wildlife Resources (DAWR) has been collecting fisheries information over the past 24 years (with only the last fifteen years of data being reliable) and, as a result, an enormous amount of fisheries management data has been accumulated. Computers have been used over the past eight years by DAWR to store and analyze this data. DAWR personnel, working closely with the National Marine Fisheries Service, have developed and purchased programs for analyzing the Division's offshore and inshore fisheries survey data.

In FY'83, a program entitled the Guam Offshore Expansion System (GOES) was developed based on the current practices of offshore data analysis and, in FY '85, a Guam Inshore Expansion System (GIES) was completed and tested for errors (this program underwent modifications in FY '90 to take advantage of the storage capability and speed of computers that are currently available). Since this time, all data collected for the offshore and inshore fisheries surveys have been analyzed through the use of these two programs.

Job 3, Fisheries Data Processing, has been jointly funded by the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the Western Pacific Regional Fisheries Management Council.

OBJECTIVES

1. Computerize the DAWR's offshore and inshore marine fisheries data and transfer the finalized fisheries data files and reports to NMFS personnel in Honolulu, Hawaii for regional application.
2. Provide technical assistance to DAWR staff biologists in the form of efficient statistical analysis and report generation.

PROCEDURES

Guam's offshore fisheries survey data are analyzed by a system of computer programs known as the GOES. This programming package is a 5-step system that summarizes,

sorts, and statistically expands the survey data to produce monthly and annual catch, effort, and species composition estimates. Two proportionality constants and a "total participation boat count" are calculated and manually entered into the expansion module by the user. Reports are generated by the GOES that give a breakdown of the estimated offshore harvest by gear type on a monthly and annual basis. Also, an estimated harvest by species is generated for each gear type with a corresponding percentage of the total catch for that gear type.

Guam's inshore fisheries survey data are analyzed by a programming package known as the GIES. The original GIES was a 4-step system that relies on two sets of survey data to determine an annual inshore estimated harvest. This program was modified this fiscal year so that the program can take advantage of the new computer technology in data storage and processing speed. The two sets of data are referred to as "inshore-participation" and "inshore-catch". "Inshore-participation" data consists of fishermen and gear counts obtained by biological aides when driving around the island and making observations on fishing activity within the fringing reef. "Inshore-catch" data are obtained by fishermen-intercept interviews that usually occur within a predetermined survey region. These data consist of a total catch and catch by species for each interview. Because of the apparent differences in participation and catch-per-unit-effort (CPUE) of the various gear types between daytime and nighttime fishing, a fisheries survey is conducted during each of these two time periods and the data are analyzed separately. Also, data are collected during the seasonal harvest of juvenile rabbitfish (*Siganus sp.*) and bigeye scad (*Selar crumenophthalmus*), but, because of the dissimilarities between the seasonal fisheries and the routine inshore fisheries, the two are analyzed separately.

RECOMMENDATION

Data processing is a valuable asset to the many research projects currently undertaken at DAWR. The need for data storage and retrieval, data analysis, programming and report generation has increased greatly since the installation of a computer system. Staff must be hired to reactivate this program.

PROJECT COST

There were no (\$0.0) project costs during FY'93.

Report prepared by: Gerald W. Davis

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO: F-1R-1
SUB-PROJECT NO: F-1
STUDY NO: 3
JOB NO: 3

STUDY 3: Studies of Guam's Recreationally-Important Fish

JOB TITLE: Biology of *Lethrinus harak*

PERIOD COVERED: October 1, 1992 to September 30, 1993

SUMMARY

Tabled since FY85, the project to study the biology of the emperor snapper, *Lethrinus harak*, resumed at the end of FY92 with the assignment of a new project coordinator. The project was expanded in FY93 to include another emperor species, *Lethrinus obsoletus*. Both emperor species are considered to be recreationally important and share much in common in terms of their biology and susceptibility to current fishing pressure.

Tagging efforts have been concentrated in Cocos Lagoon and are being conducted one day a week, sometimes more, depending on tide, lunar cycle, weather conditions and available manpower. Tagging procedures have been modified to include field sampling for the presence of milt or eggs before a tagged fish is returned to the water. Egg samples collected are immediately preserved in a 10% formalin solution and will be examined for stage of development and maturity at a later time. Laboratory equipment necessary to complete examination of the egg samples are expected to arrive in early FY94.

Incidental catches of other species of fish are also being tagged, but not checked for milt or egg production.

Preliminary observations of Lethrinid tag recoveries suggest that tagged *L. obsoletus* may have some temporal tendency to be resident to specific seagrass areas in Cocos Lagoon. Of the nineteen tag recoveries made thus far, all have been made within a half-mile radius of where the fish were originally caught, tagged and released usually less than three months from the time of tagging.

Data collected in FY93 and beyond will be compiled with FY85 data to yield more comprehensive results on the growth, reproduction, and movement of these two species of emperors. Based on the findings of the study, recommendations may be made for the management and preservation of stocks of *L. harak* and *L. obsoletus* in Guam's waters.

BACKGROUND

The family Lethrinidae (emperors) are close relatives of snappers but differ primarily by having a maxillary completely hidden by a bare or near-bare preopercle and conical or molariform teeth on the sides of the jaws. Lethrinids also have fairly thick lips, canine teeth towards the front of the jaws, a continuous dorsal fin with X spines and 9 to 10 rays, and an anal fin with III spines and 8 to 10 rays (Myers, 1991).

Lethrinus harak, commonly known as the blackspot or thumbprint emperor, inhabits mangroves, coral rubble, shallow sandy lagoons, channels, and seagrass areas adjacent to coral reefs. It feeds on crustaceans, molluscs, polychaetes, echinoderms and small fishes, and grows to about 30 cm total length. *L. harak* have been reported to spawn in large aggregations year-round during the first five days of the lunar month in lagoons of Belau (Carpenter & Allen, 1989).

Lethrinus obsoletus, commonly known as the orange-striped emperor, is also found in seagrass beds and sand and rubble areas of lagoons and reefs. Much like *L. harak*, *L. obsoletus* feeds primarily on crustaceans, molluscs and echinoderms, and grows to about 30 cm in total length. In Belau, spawning is reported to occur at the outer reef edge during the first five days of the lunar month between November through April (Carpenter & Allen, 1989). *L. harak* has been observed by fishermen to burrow in the sand (Schroeder, 1980) which may serve as a means of escaping their predators and drag nets.

OBJECTIVE

To investigate need for management of Guam's recreationally important fish through analysis of fishing pressure, population dynamics and life history studies.

METHODS

The study of *L. harak* and *L. obsoletus* will include the following parameters: size distribution, sex ratio, spawning seasonality, lunar occurrence of spawning activity, reproductive contribution among the various size classes, and historic harvest analysis.

Tag and release of *L. harak* and *L. obsoletus* will be conducted on a once-a-week basis, sometimes more, as tide, lunar cycle, weather conditions and manpower permit. Upon capture, the fish will be measured (fork length), tagged and then released. Based on field experience, those fish that have the hook imbedded back by the pharyngeal teeth or on a gill arch, will be measured and recorded as "boxed fish", but not tagged or released since they usually perish after the hook removal process.

An additional procedure has been incorporated in the tagging routine to complement previous spawning periodicity data collected back in FY85. After tagging, the fish is inverted and checked for gonad maturity before being returned to the water. Ripe males will release milt with one or two light strokes from the pelvic fin to the vent. If no milt is released, a 12"-long canula, I.D. .034", O.D. .050", is inserted approximately 1 - 2 inches, and then light suction is applied to draw a sample. If no milt or eggs are extracted by the procedures, the fish is labeled "NS" for "no sample".

Laboratory examinations of egg samples among the various size classes and sampling dates will be conducted to determine egg developmental stage based on diameter. Lunar phase will be noted to determine if *L. harak* and *L. obsoletus* are indeed serial spawners following a lunar cycle, and whether or not there are spawning peaks during the year. Histological data collected in FY85 will be supplemented with the above information gathered in FY93 and beyond.

Computer processing of inshore catch records for *L. harak* and *L. obsoletus* since FY85 will provide for a historic analysis of the exploitation trends of the species over the years.

RESULTS

Manpower

DAWR is continuing efforts to acquire additional staff to assist with the Lethrinid tagging project by creating new positions and filling vacancies within the Fisheries Section. A Technician I and a Biologist I were hired in FY93 to contribute part-time to the project, and an additional Technician I position has also been approved. The latter position, which will also provide assistance for the Lethrinid tagging project, is expected to be filled, by early FY94.

Equipment

All the necessary fishing equipment, including a three-man, 14' boat, were purchased in mid to late-FY93, which has helped considerably to increase sampling efficiency. Prior to receiving the equipment, sampling was conducted in DAWR's two-man, 12' boat and with equipment borrowed from DAWR staff. Laboratory equipment necessary to conduct examinations of egg samples and histological procedures were ordered in late-FY93, and is expected to arrive by early-FY94.

Press Release and Tagging Poster

A press release and poster has been issued by DAWR notifying the public of the tagging project. Since incidental catches of other species of fish are being tagged as well, the press release and poster include descriptions of the other fishes being tagged. The tagging poster includes information on the purpose of the tagging study, what to record if a tagged fish is recovered, and how to contact DAWR (Figure 1).

Inshore Catch Analysis - FY85 to FY93

Compilation of inshore catch records since FY85 for *L. harak* and *L. obsoletus* was not conducted because a replacement for the data processing specialist position left vacant in FY92 has yet to be hired. Eventual compilation and analysis of the data will provide a historic analysis of the exploitation trends of the species.

Fecundity

The FY92 recommendation to begin sampling for reproductive contribution among the size classes of females was not conducted in FY93 due to a shortage of laboratory equipment and available time. Some Lethrinid fecundity work was initiated in FY85, however, as with much of the FY85 work, the data has yet to be compiled or subjected to statistical analysis.

Tag and Recapture Summary

DAWR tagging efforts began on August 13, 1993. As of the end of this reporting period, 43 trips have been made resulting in a total of 1,359 fish being tagged, 19 of which have been recaptured and reported. Of the 1,359 tagged fish, 228 were *Lethrinus harak* (1 recaptured), and 541 were *Lethrinus obsoletus* (16 recaptured). Table 1 provides a breakdown of tagged and recaptured fishes according to species.

Of the nineteen tag recoveries made thusfar, all have been made within a half-mile radius of where the fish was originally caught and tagged, and usually within three months from the time of tagging. Initial observations suggest that the tagged Lethrinids, especially with *L.*

obsoletus, may have some temporal tendency to remain resident to specific sea-grass areas within Cocos Lagoon.

Table 1. FY93 Tagging Effort Summary.

SPECIES	NUMBER TAGGED	TAG RECOVERIES
<i>Lethrinus harak</i>	228	1
<i>Lethrinus obsoletus</i>	541	16
<i>Lethrinus xanthurus</i>	20	1
<i>Lethrinus atkinsoni</i>	13	0
<i>Lethrinus olivaceus</i>	4	0
<i>Epinephelus merra</i>	503	1
<i>Epinephelus polyphekadion</i>	1	0
<i>Lutjanus fulvus</i>	19	0
<i>Lutjanus kasmira</i>	9	0
<i>Lutjanus monostigmus</i>	10	0
<i>Lutjanus argentimaculatus</i>	1	0
<i>Parapeneus barberinus</i>	3	0
<i>Parapeneus multifasciatus</i>	1	0
<i>Novaculichthys taeniorus</i>	1	0
<i>Cephalophilus urodeta</i>	3	0
<i>Bodianus axillaris</i>	1	0
TOTAL	1,358	19

Incidental catches of other species of fish are also being tagged, but not checked for milt or egg production.

RECOMMENDATIONS

Given the current annualized catch and tag recovery rate of *L. obsoletus* (541 tagged, 16 recovered), and if the variance in growth data remains low, it appears that the number of recaptures necessary to conduct a robust statistical analysis of growth data ($n > 30$) may be attained after at least one more year's worth of tagging effort. However, the annualized catch and tag recovery rate for *L. harak*, requires that close to 7,000 *L. harak* be tagged in order to achieve a minimum of 30 tag recaptures. At the current annualized catch rate of *L. harak*, it would take 31 years to tag that number of fish! Because of the relatively low catch rate for *L. harak*, growth data may have to be derived from otolith studies, or sampling efforts modified to increase catch and tag recovery success (i.e., investigating other potential habitat sites). Consideration may also be given to utilizing *L. obsoletus* as a growth and population indicator species for *L. harak*.

With the hiring of additional staff, the expected arrival of laboratory equipment necessary for histological work, and at the present level of tagging effort which includes increased egg sampling (twice weekly) during the weeks surrounding the anticipated Lethrinid spawning windows, the project to study the biology of *L. harak* and *L. obsoletus* may see finalization by the end of FY95.

This project will provide valuable information essential for the future management of Guam's stocks of *L. harak* and *L. obsoletus* and should be continued with the following recommendations for FY93:

1. Continue weekly tagging and sampling efforts with additional (twice- weekly) tagging trips on the weeks prior to, during, and after anticipated spawning windows.
2. Consider use of otolith studies to aid in determination of growth rates of *L. harak*.
3. Continue efforts to hire additional fisheries staff to facilitate regular tagging and sampling trips, and to compile and analyze previous Lethrinid data.
4. Begin laboratory examination of egg sample collection for average diameter, stage of development and size-frequency distribution relative to lunar cycle and month.
5. Issue updated press releases of tagging program and continue distribution of posters to fishing tackle shops, boat dealers, mayor's offices and appropriate government agencies.
6. Encourage public awareness and involvement with tagging and catch-and-release practices by providing reputable fishermen with tagging equipment and record-keeping material.

PROGRAM COST

The estimated cost of the *Lethrinus harak* project is \$59,815.

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Report prepared by: Andrew A. Torres

JOB PROGRESS REPORT COORDINATION PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: F-1R-1
SUB-PROJECT NO.: F-3
JOB NO.: 1

JOB TITLE: Technical Guidance to Projects Affecting Guam's Fish Resources (2710,2720)

PERIOD COVERED: October 1, 1992 to September 30, 1993

BACKGROUND

The Division of Aquatic & Wildlife Resources' (DAWR) professional Fisheries Staff devoted a significant percentage of their time and effort to technical assistance. The rapid pace of development on the island is requiring increasing amounts of time from the Fishery Staff to fulfill its statutory responsibility to review and comment on development plans, rezoning applications, and various permit applications. Because of the size and complexity of some of these developments, the Fisheries Staff's review responsibility will require a continuing commitment that could extend even beyond project completion.

In response to the increase in workload, the Division created the Technical Assistance Program (TAP) within the Administration/Coordination Section. A local appropriation provides funding for two technical assistance staff members, a Biologist I and a Biologist II. These staff are primarily responsible for reviewing projects submitted to the Development Review Committee for action by the Territorial Land Use Commission and for the review of clearing and grading permit applications, but they also participate in the review of other permit applications and environmental documentation. The professional staff within the Fishery Section provide technical support to the TAP staff, and occasionally take the lead in the review of projects involving their particular expertise, such as those that may have endangered species (sea turtles) impacts and those involving coral reefs.

OBJECTIVES

1. To minimize adverse environmental impact resulting from the construction of recreational, commercial, residential, industrial or public utility facilities.
2. Provide technical assistance to military and civil agencies relative to the management and protection of fish resources.

FINDINGS

Fisheries Staff have been actively involved in the technical guidance function during this segment. Numerous development plans, impact statements, and permit applications have been submitted to the Division for review. Field investigations and meetings with responsible agencies have been conducted in many cases as a part of the review process.

Various Fisheries Staff members actively serve as members of the following groups:

1. Recreational Water Use Master Plan

2. Western Pacific Regional Pelagic Plan Monitoring Team
3. Western Pacific Regional Bottomfish Plan Monitoring Team
4. Guam Aquarium Council
5. Seashore Protection Plan Task Force
6. Sea Grant Advisory Council

Members of the Division have attended numerous meetings and hearings pertaining to the protection of Guam's natural resources and have actively consulted with various civil and military agencies on environmental matters. Division staff maintain close liaison with the Department of Land Management, Department of Parks and Recreation, Guam Bureau of Planning, Guam Environmental Protection Agency, University of Guam, U.S. Army Corps of Engineers (ACOE), U.S. Fish and Wildlife Service, Western Pacific Regional Fisheries Management Council, National Marine Fisheries Service, U.S. Navy, the U.S. Coast Guard, and U.S. Air Force regarding matters of environmental concern. In addition, staff members actively consulted with the numerous off-island visitors, representing various agencies and organizations, who visited during the segment.

Considerable public contact was maintained by Fisheries Staff during the reporting segment. In addition to occasional interviews on radio, television, and in the newspaper, they also gave talks to a number of civic groups, and school.

Some specific Technical Assistance activities provided by the Fisheries Section included:

1. Technical support to the Divisions TAP staff who represent the Department and the Division on the Development Review Committee, which met biweekly to review applications for rezoning, variances, and various types of development.
2. Additional review and comment on the proposed ABC Condominium Dredging Project and revisions thereof.
3. Reviewing and commenting upon a number of permit requests for development on Cocos Island by Cocos Lagoon Development Corporation (CLCD). These included the master plan modification for the Cocos Island Resort, CLDC use of the Government of Guam LCM ramp, the periodic maintenance dredging in the channel for an existing LCM ramp as well as an after the fact permit for the existing ramp, construction of a concrete and wooden cabana structure, construction of a jet ski ramp, installation of five storm moorings in Cocos Lagoon, and construction of new LCM ramp at Cocos Island. In addition, the Division participated in the review of CLDC's proposal to restore the northern portion of Cocos Island by recovery of sand washed off the island by Typhoons Russ and Yuri, construction of an additional seawall on the seaward side of the island to provide protection against future storm wave damage, and removal of post-typhoon debris. The prime concern in the review of all these activities was their potential impact on the existing avian colonies and on sea turtle nesting.
4. Participating with, and providing comments and assistance to, the Guam Environmental Protection Agency and the Office of the Attorney General in negotiations with Miyama Development Incorporated (MDI) regarding water rights issues.

5. Offering comments to and provided information to the Western Pacific Regional Fisheries Management Council (WESPAC) and the Plan Monitoring Team (PMT) on projects for bottom and pelagic fisheries. Information was provided on market sampling, and stock assessment, and from recreational and near-water commercial vessels.
6. Reviewing and commenting on several legislative bills, which would affect fisheries.
7. Meeting with Government agencies and provided information on several occasions regarding the user conflict between mechanized craft and fishermen in East Agana Bay.
8. Investigating several reports of suspected fish kills in island waters during the year.
9. Responding to many requests for information on laws and regulations pertaining to fish, endangered species, fishing, and importation of fish.
10. Reviewing manuscripts for other authors and for professional journals.
11. Providing technical assistance to the Attorney General's Office in interpreting the laws and regulations that apply to fish resources. In addition, the Section requested for several legal opinions in regards to environmental issues.
12. Making several presentations on fish resources to other organizations or groups during the year.
13. Providing technical assistance to the Guam International Fishing Derby.
14. Meeting with numerous developers and their consultants and other government representatives to discuss their proposed development and its possible impacts on endangered species, wetlands and native habitat as well as erosion, project design, coral reefs, etc.
15. Providing input regarding candidate sites for conservation and marine reserves includes a Marine Conservation Area proposed by Andersen Air Force Base.
16. Providing comments to the Government of Guam Bureau of Planning regarding Federal Consistency Application for the structural improvement of X, Y, and V Pier at Apra Harbor, to include improvements by dredging at Reserve Craft Beach and the Commercial Port.
17. Providing comments to the Regional Fisheries Training Project regarding the draft South Pacific Commission, Fisheries Human Resources Survey Guam Report.
18. Providing statistical data on fisheries issues to the Bureau of Planning and Department of Commerce as supplemental information for local annual reports.
19. Providing additional review and comment on the revised proposal to construct and underwater observatory on the Piti reef flat
20. Participating in the observation and submitting comments to the USFWS and GEPA on the U.S Navy's attempt to remove submerged pilings by blasting at SRF Dry Dock Facilities.

21. Participating in meetings and submitting recommendations on the U.S. Navy's proposal to refurbish moorings for buoys in Apra Harbor. Also, provided were comments and collaboration with GEPA and the University of Guam, Marine Lab on the protection and assessment of damaged coral and sponge flats.
22. Participating in the review and submitting comments on Mine Exercises to be conducted by the U.S. Navy.
23. Contributing to the review and submittal of comments on the Manengon Hills Project requesting to construct an effluent pipe at the confluence of the Manengon and Ylig River.

PROGRAM COST

The estimated cost of the Technical Assistance project is \$31,760

RECOMMENDATIONS

Continue technical assistance activities but allocate the federal costs involved between F-1R and W-1R.

Report prepared by: Robert D. Anderson, Gerald W. Davis, Marvin Aguilar, and
Georgette Concepcion

JOB PROGRESS REPORT DEVELOPMENT PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO: F-2-D
SEGMENT: 6

JOB TITLE: Marine Fish Habitat Improvement and Aggregating Devices (2323)

PERIOD COVERED: October 1, 1992 to September 30, 1993

SUMMARY

Fish Aggregating Devices

Fish aggregating devices (FADs) continue to be popular among local fishermen and requests for additional FAD sites have been incorporated in the Division of Aquatic and Wildlife Resource's (DAWR) FAD program expansion plans. As of this reporting period, four sites are currently operational - Adelup Point, Haputo Point, Facpi Point and Cocos Island. The Facpi Point and Cocos Island FADs that were lost in August, 1992 were replaced by December, 1992. Six other sites have been identified but are not yet operational, three of which have already been permitted by the Army Corps of Engineers (ACOE) - Pati Point, Fadian Point and Asiga Point; the other three have been submitted for ACOE approval - Uruno Point, Ritidian Point and "Nine-mile" (Figure 1. FAD Sites). DAWR efforts in FY94 will continue to concentrate on preparations to activate all the proposed FAD sites while maintaining an adequate inventory of backup systems to serve as immediate replacements for any lost systems. Concern about the rising costs of FAD systems, especially the cost of deployment services, has prompted DAWR to investigate possible alternatives in FAD system design and deployment strategies. Several cost-cutting possibilities include the use of a lighter, more durable buoy design and the purchase of a service vessel and barge capable of deploying FADs. Additional manpower is still being sought to continue regular maintenance checks and to conduct fishing surveys of the FADs.

Shallow Water Moorings

No activity was recorded in FY93 for the shallow water mooring project.

Fish Aggregating Devices

BACKGROUND

Guam's most productive trolling occurs in the vicinity of offshore banks such as White Tuna Bank, Santa Rosa Reef, Galvez Bank, Eleven-mile Bank and Rota Bank. However, because of their distances from the island's marinas and boat launches, these fishing areas are not always safely accessible for many boats, especially during inclement weather. Furthermore, the amount of fuel consumed to reach the popular fishing banks usually makes the fishing trip an expensive outing.

Fish aggregating devices (FADs) are effective in attracting and holding pelagic migratory fish such as yellowfin (*Thunnus albacares*) and bonita (*Katsuwonus pelamis*) tuna, kawakawa (*Euthynnus affinis*), wahoo (*Acanthocybium solandri*), mahi mahi (*Coryphaena hippurus*) and blue marlin (*Makaira nigricans*), in offshore coastal waters (Kanenaka and

Higashi, 1989). Although the FADs will increase the harvest of Pacific migratory fishes in Guam's waters, the additional pressure will have no significant impact on the fish stocks. Guam's harvest will remain small-scale and only represent an extremely small percentage of the total amount of migratory fish that pass through the island's offshore waters.

FADs have no adverse impact on non-migratory pelagic or demersal fish, fauna, wildlife and other natural environmental values, and conform to United States Coast Guard requirements for marking, lighting and standardization of aids to navigation.

Installation of FADs in Guam's offshore coastal waters began in 1979, initially with funding from the Saltonstall-Kennedy Act through the Pacific Tuna Development Foundation. The Guam FAD project is currently being continued as part of Dingle-Johnson/Wallop-Breaux Sport Fish Restoration program.

OBJECTIVE

DAWR's objective is to develop, deploy and maintain fish aggregating devices in the nearshore waters off Guam.

PROCEDURES

Procedures for construction and deployment of the Facpi and Cocos FADs during FY93 followed methods recorded in the FY91 and FY92 annual reports.

Sea conditions permitting, routine monitoring and maintenance of the FADs were conducted on a biweekly basis. On several occasions, scheduled maintenance trips were postponed due to the DAWR boat being out of service or because of a shortage of manpower to properly and safely conduct the maintenance procedure.

RESULTS

Renewal of FAD Project Permit

On October 16, 1992, the Division of Aquatic and Wildlife Resources (DAWR) was issued Nationwide Permit 4 No. GNW 93-002 by the Army Corps of Engineers (ACOE) to replace General Permit No. PODCO-O GP 82-3 which expired on April 14, 1992. The Nationwide Permit 4 (Fish Harvesting Devices) authorizes DAWR to continue the installation and maintenance of FADs at designated sites in the offshore coastal waters around Guam, but is valid for only a two-year period instead of the ten years previously granted under the General Permit. In spite of its comparatively short duration of two years however, the Nationwide Permit 4 can be modified and renewed expeditiously since authorization is granted through the local ACOE regional office on Guam. Due to ACOE permit revisions, DAWR FAD project permit requests must be processed under ACOE's Nationwide Permit authority since the General Permit category will no longer apply.

Prior to the issuance of GNW 93-002, DAWR complied with ACOE's request to forward FAD program concurrence by Gov. Guam's Bureau of Planning for Coastal Zone Management Program consistency, Environmental Protection Agency for 401 Water Quality compliance, and clearance from the Department of Parks and Recreation's Historic Resources Division.

Receipt of GNW 93-02 allowed DAWR to redeploy the FADs at the Cocos and Facpi sites that were lost during August of 1992. The December 1, 1992 redeployments brought the

number of operational FADs in the DAWR program back up to four: Cocos Island, Facpi Point, Adelupe Point and Haputo Point (Figure 1 - "Operational" sites).

New Sites

DAWR has requested ACOE to modify the current Nationwide Permit to include three additional FAD sites - "Urunao Point", "Ritidian Point" (as recommended in FY93), and "Nine-Mile". Each of the three new sites are designated in Figure 1 as "new site to be permitted". Thus far, four FADs remain operational and six more are scheduled to be deployed by FY95, which would bring the DAWR FAD program up to a total of ten systems (Figure 1).

FAD Inspection, Maintenance and Fishing Surveys

FAD inspection, maintenance and fishing surveys are currently being conducted on a biweekly basis as sea conditions and available manpower permit. The DAWR FAD program service vessel (19'6" Enterprise "Corwin") launches from the Agana Boat Basin for trips to the northern buoys - Adelup Point and Haputo Point, and then on the following week, from either the Agat Marina or Merizo Pier for trips to the southern buoys - Facpi Point and Cocos Island.

The maintenance routine of a FAD includes occasional underwater inspection of shackle wear at the buoy/chain junction and a check on the condition of the navigational light. A voltage meter is used to measure the battery charge during each light inspection. If the voltage reading falls between 3.0 and 4.0 volts, the light is replaced because the McDermott system currently in use yields a very dim flash below 4.0 volts, and ceases to flash altogether below 3.0 volts (based on the use of 6-volt super-heavy duty carbon lantern batteries). Also included in the maintenance procedure is an inspection for burned-out light bulbs, a defective photocell or a malfunctioning lighting mechanism.

In early FY93, fishing surveys of FADs were conducted as part of an in-house effort to collect data on the effectiveness of each FAD, but were later temporarily discontinued due to a shortage of available man-hours. Fish caught during the survey were identified, measured and recorded, and then returned to the water. Several fish were tagged to determine the feasibility of such a procedure for FAD studies in the future. The relative success of the fishing effort during the in-house surveys resulted in occasional mortalities, which later raised the concern as to the disposition of this catch. DAWR protocol for such "takes" is to donate the catch to a local rest home and has since been implemented. Compilation of the data collected from earlier DAWR in-house FAD surveys was not expanded due to insufficient data collection and a shortage of staff.

Other FAD fishing information, usually collected via the offshore creel surveys, were also discontinued in FY93 because the data is now viewed by DAWR as extraneous and often times unreliable. One of the major inconsistencies of this survey concerns the distinction between when a boat is fishing, or not fishing, a FAD (i.e., upon visual contact, within 100 yards, 1 mile, 2 miles, 4 miles, etc.). The fact remains that there is little question that the FADs work and that the overall value of the catch from a FAD well exceeds the actual cost of the FAD itself.

DAWR is continuing efforts to acquire additional staff to assist with the FAD program by creating new openings and filling vacancies within the Fisheries Section. A Technician I and a Biologist I were hired in FY93 to contribute part-time to the FAD program, and an additional Technician I position has also been approved. The latter position, which will



Figure 1. FAD Sites

also provide assistance for the FAD program on a part-time basis, is expected to be filled by early FY94.

FAD Equipment Inventory

A shipment of FAD mooring equipment, enough for ten, 500-fathom systems, was received at the beginning of FY93. Included in the shipment were nylon and polypropylene line, chain, shackles and thimbles; essentially all the basic components of a FAD mooring system.

Two of the above mooring systems were utilized for the December, 1992 FAD deployments at Facpi Point and Cocos Island, leaving eight 500-fathom systems available for expeditious replacement of lost FADs or new site deployment. Because DAWR intends to bring the number of operational fishing buoys in its FAD program up to ten systems by the end of FY95, additional equipment will have to be procured to accommodate future new-site deployments as well as old-site replacements.

The last two sets of 3/4-ton (1,500 lb.) pyramid-shaped anchor blocks were used for the above December, 1992 deployments. The use of two anchor blocks instead of one, came from concern that a single 3/4-ton anchor was insufficient weight to hold the buoy system in place. However, there is now some concern that the descent pattern of a two-block system may result in one crashing into the other upon landing, possibly damaging one block or both in the process. For this reason, twenty pyramid-shaped 1 & 3/4-ton (3,500 lb.) anchor blocks were acquired in June, 1993, to replace the previous smaller design.

Only two buoys remain in the DAWR inventory, which are being reserved as replacements since all of the four currently operational FADs have exceeded the average time on station of eight months (as of September 30, 1993 - Adelup Point and Haputo Point: 18 months; Facpi Point and Cocos Island: 10 months). Priority has been given to acquiring, as soon as possible, another twenty buoys for replacements and new sites.

FAD Deployments

The Facpi Point and Cocos Island FADs that were lost in early August, 1992, were reinstalled on December 7, 1992. The same vessel that conducted the last set of deployments back in March 27, 1992 (Adelup Point, Haputo Point, Facpi Point and Cocos island), the M.V. Ocean Dolphin, was contracted once again to set the FADs. DAWR personnel were on board the Ocean Dolphin during the deployments to ensure that proper procedures were followed, and to witness if the deployments were indeed successful. The Facpi Point and Cocos Island buoys are still operational as of this reporting period.

The almost four months that passed from the time the Facpi Point and Cocos Island buoys were reported lost back in August 1992, to the time that they were replaced in December 7, 1992, was the result of a combination of factors: 1) the expiration of the ACOE General Permit and DAWR's subsequent application for a Nationwide Permit to replace it, 2) the previous lack of an adequate inventory of FAD mooring equipment, and 3) the unavailability of a properly equipped and experienced deployment vessel after the necessary permit and equipment were acquired.

FAD Losses

No FAD losses occurred during FY93. As part of an effort to increase the chances for recovery of any lost DAWR FADs, plans have been made to paint or affix easily visible I.D. information on the buoys including FAD station and coordinates (i.e., "Adelup FAD-

13°32.8'N/144°41.8'E"), country and agency of origin ("Guam, U.S.A.-Div. of Aquatic and Wildlife Resources"), and contact information if found derelict ("P.O. Box 2950, Agana, Guam 96910, (671) 734-5283"). Such information may lead to the recovery of recently lost buoys or provide information regarding the drift pattern of lost buoys.

Buoy Modifications

In order to comply with U.S. Coast Guard requirements, as well as to protect the FADs from collisions with larger vessels, radar reflectors (Davis "Echomaster" Standard #152) were purchased and modified for installation on DAWR FADs. The radar reflectors were installed on the Facpi Point and Cocos Island FADs on September 3, 1993; and on the Adelup Point and Haputo Point FADs on September 15, 1993.

In addition to the installation of the radar reflectors, two bands of two-inch wide reflective tape were placed on each of the FAD light posts as a further precautionary measure.

As recommended in the FY92 annual report, attachment of counterweights to the currently operational buoys would greatly reduce the amount of sway and help to keep the buoy more up right. However, the initial plan of adding more chain or any other form of weight to the buoy/mooring assembly was abandoned because of DAWR vessel and equipment limitations. The proposed operation would have been of more costly and dangerous than it was worth. To avoid this problem in the future, the specifications for the twenty buoys DAWR hopes to acquire in FY94 will include the installation of counterweights.

FAD Deployment Vessel

The March 27, 1992 and December 7, 1993 FAD deployments were done at a cost of \$4,500.00 per FAD. This figure represents almost 50% of the total cost of a single FAD system, but was accepted because no other U.S.-flagged vessel that was properly equipped, experienced, and adequately insured was available to compete for the contract. To complicate matters further, the above-mentioned vessel has already announced plans to leave Guam's waters permanently in 1993. DAWR is thus placed in the situation of having to hire the first available vessel that is properly equipped, experienced and insured to deploy FADs, and happens to be in port, rather than on which qualified vessel submits the lowest bid to do the job.

In addition to continuing its search for such qualified FAD deployment vessels, DAWR is also considering the possibility of procuring its own combination FAD maintenance/towing vessel and a barge to conduct the deployments.

FAD System Cost Analysis

The current cost per FAD system and deployment, excluding maintenance and surveys, is listed below:

<u>ITEM</u>	<u>UNIT COST</u>
Cement Anchor Block	\$571.43*
Mooring System	\$2,686.00*
Buoy	\$500.00*
Buoy Light	\$ 171.29*
Bottom Contour Survey	\$1,000.00*
Deployment	\$4,500.00
TOTAL COST/FAD	\$9,428.72

*from R. Hensley, 1990

RECOMMENDATIONS

Fish Aggregating Devices

FADs remain quite popular with local fishermen and are most noticed when the systems are no longer on site. The project should be continued with the following recommendations:

1. Continue search for potential Guam-based FAD deployment vessels.
2. Obtain amended ACOE Nationwide Permit 4 to authorize DAWR's ten proposed FAD sites.
3. Acquire inventory of new and back-up FAD buoys; complete all buoy modifications and markings before deployments.
4. Consider alternative buoy system designs for eastern windward sites.
5. Reorder equipment and supplies for FAD mooring systems to maintain an inventory of at least ten systems.
6. Purchase bottom-sounding equipment adequate for FAD project use; conduct bottom contour surveys of Uruno Point, Ritidian Point and Nine-Mile FAD sites.
7. Continue deployment of FADs at new sites.
8. Purchase reliable commercial-duty vessel capable of FAD maintenance and deployment.
9. Consider design and purchase of FAD deployment barge and trailer.
10. Allocate additional manpower to deploy, maintain and survey FADs.
11. Design more appropriate FAD survey method.
12. Investigate use of other navigational lighting systems that are more economical, reliable and long-lived than the present systems.

Shallow Water Moorings

The popularity of water-related activities has resulted in an increase in damage to coral reefs near popular sites caused by the setting of anchors. The installation of mooring buoys is one way of reducing such damage. However, due to a continued shortage of manpower in the Fisheries Section and the amount of time that has lapsed since the need for mooring buoys was originally identified, DAWR recommends that the project be sub-contracted out to prevent any further delays in the deployment of the shallow water mooring buoy systems.

LITERATURE CITED

- Hensley, R. 1990. Construction of Fish Aggregation Devices and Development of a Shallow Water Mooring System. Annual Report Fiscal Year 1990, Division of Aquatic and Wildlife Resources, Department of Agriculture, Government of Guam.
- Kanenaka, B. & Higashi, G. 1989. Artificial Fish Shelter/Fish Aggregating System Development and Operation. Job Progress Report 1989, Hawaii Division of Aquatic Resources.

Report prepared by: Andrew A. Torres

JOB PROGRESS REPORT DEVELOPMENT PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO: F-2-D
SEGMENT: 7

JOB TITLE: Construction of Boating Access Facilities (2332)

PERIOD COVERED: October 1, 1992 to September 30, 1993

SUMMARY

The Merizo Pier project began with a groundbreaking ceremony on April 30, 1991 and was completed on July 24, 1992. Official dedication ceremonies are being planned for the next fiscal year.

Other projects being pursued include the construction of small boat ramps on the eastern side of Guam and the repair and enhancement of the existing marinas and small boat ramps. A new project coordinator has been assigned to these projects.

BACKGROUND

The original proposed project at the Merizo Pier was to repair and extend the existing pier. Upon inspection of the original pier, it was determined that the pier had deteriorated to the extent that renovation was impractical. During FY88, the project was modified to replace the existing pier with a new pier. During FY89, the plans to construct a new pier were finalized with the Department of Public Works named as the contract administrator and the International Bridge Corporation being awarded the construction contract. The groundbreaking ceremony was held on April 30, 1991 with the project being completed on July 24, 1992. The Merizo pier was constructed with a handicap access ramp. Since its completion, the pier has been used extensively by fishermen and boaters. This project was funded in its entirety by Grant F-2-D-7 from the Federal Aid in Sport Fish Restoration Program, administered by the U.S. Fish and Wildlife Service to the Division of Aquatic and Wildlife Resources at the Department of Agriculture.

Plans to construct small boat ramps on the eastern side of Guam have been ongoing. These boat ramps would provide access to fishing grounds on the eastern side of Guam and provide a safe port for boats during emergencies. Recently, boaters have been observed regularly launching off the southern bank of Ylig River. As many as seven vehicle-trailers (VT's) have been observed parked adjacent to Ylig Bridge in a small clearing and across Route 4. This indicates a need for small boat launching facilities to provide access to fishing and boating resources on the eastern side of Guam.

OBJECTIVE

To increase boating accessibility to fishing grounds through the creation of safe strategically located boat launching facilities.

RESULTS

Since the completion of the Merizo Pier, boaters and fishermen have been using the pier extensively. A 4' x 3' project sign was installed on August 14, 1993 dedicating the completion of the Merizo Pier project. The total project construction cost was approximately \$387,000.

RECOMMENDATIONS

The construction of small boat ramps on the eastern side of Guam and the repair and enhancement of the existing small boat ramps should be further pursued. Potential boat ramp sites should be evaluated for land ownership, boating accessibility, traffic safety, exposure of the ramps to wave action and sediment deposition, and other factors. The existing small boat ramps should be evaluated for enhancement and repair projects. Repair projects could include repair of holes and cracks on the ramps and repair of the worn-out grooves on the ramps. Enhancement projects could include providing additional lighting and rinsing facilities, the addition of cleats along the ramps to enable single boaters to tie up to, constructing additional and improving the parking facilities, installing wood or rubber material around the ramps to protect boats from damage, and maintaining and adding channel markers or buoys to improve navigation.

Assessments for the development of additional boating ramp sites and for the repair and enhancement of existing boat ramps should be continued. The data acquired should be organized to begin initiating these projects to the proposal stage. It is recommended that the project be closed at the expiration of the AFA and new Grant Agreements for each discrete development be initiated.

PROGRAM COSTS

The estimated costs of the Boating Access Project (F-2D-7) to date is approximately \$482,000, with approximately \$397,000.00 of that being actual construction costs for the Merizo Pier. FY93 costs were \$38,217.48.

Report Prepared by: Thomas Flores, Jr.

JOB PROGRESS REPORT DEVELOPMENT PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: F-2-D
SEGMENT: 2

JOB TITLE: Development of Inshore Fishing Access Facilities (2331)

PERIOD COVERED: October 1, 1992 to September 30, 1993

SUMMARY

During FY93, the reef fishing platform design was completed. Next, the environmental clearances will be sought with the local and federal government. After the approvals have been given, we will have the project put on bid for construction.

BACKGROUND

The historical, traditional use and design of fishing platforms has been reviewed in previous fiscal year reports (Kruckenberg, 1989; Kruckenberg, 1990; Kruckenberg, 1991; Kruckenberg, 1992). Because inshore fishing continues to be a popular activity, there is a real need to provide greater accessibility to inshore fishing areas and improved safety in areas that are typically unsafe.

OBJECTIVE

To plan, design and construct inshore fishing access facilities (reef flat platforms and cliff platforms) on the windward coast of Guam and research the possibilities of alternate sites on the leeward coast.

PROCEDURE

The Division of Aquatic and Wildlife Resources (DAWR) has been actively pursuing the planning, design, site selection, environmental review and construction of the reef flat fishing platforms. The primary focus during FY93 was to complete the fishing platform plans and construction documents.

RESULTS

The fishing platform design and engineering plans have been completed. The final set of drawings have been finished and reviewed by the office staff. The drawings have incorporated modifications that will make the fishing platform safer and more practical.

Ten sites are actively being considered for fishing platforms around Guam: (1) Pago Bay, (2) Ylig Bay, (3) Togcha Bay, (4) Talofof Bay, (5) Agfayan Bay, (6) Ajayan Bay, (7) Toguan Bay, (8) Togcha Beach Cut, (9) Tepungan Channel and (10) Asan Bay (Figure 3). Specific site information is available upon request.

DISCUSSION

Because the design plans have been completed, environmental clearances for site approval will be initiated. Clearances will be required from the Federal Aid Program, the Territorial Seashore Protection Commission, the Guam Environmental Protection Agency (Environmental Protection Plan and Water Quality - 404, 401), the Coastal Zone Management Program and the U.S. Army Corps of Engineers. The clearances will be completed as soon as possible. After clearances have been awarded, the project will be placed on bid to fabricate and install the platforms.

RECOMMENDATIONS

This program has valuable traditional fishing application for Guam while providing a safety factor and enhancing fishing opportunities. We therefore recommend that this job continue to develop a fishing platform program on Guam.

PROGRAM COSTS

The estimated cost of the reef platform project to date is approximately \$68,302.

Prepared by: Wayne Kruckenberg

JOB PROGRESS REPORT DEVELOPMENT PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: F-2-D
SEGMENT: 10

JOB TITLE: Masso Reservoir Restoration (2322)

PERIOD COVERED: October 1, 1992 to September 30, 1993

SUMMARY

A general assessment of the fauna, habitat and facilities on the old Masso Reservoir project site has been conducted. A new scope of work has been developed to include repair or renovation of old facilities as well as considerations for improvement to the old concept.

BACKGROUND

The Masso Reservoir project will provide a safe and easily accessible freshwater fishing experience for the people of Guam. The opportunities for freshwater fishing on Guam are limited. With the numerous fishing derbies sponsored by Division of Aquatic and Wildlife Resources (DAWR) at Fena Lake not open to the general public, people have wanted more areas available for freshwater fishing. The reservoir could serve as an excellent resource for aquatic education and providing an area to promote freshwater fishing.

Our office has tried in the past to work with developing Masso Reservoir for sport fishing (F-2-D Segments 1-5). The US Navy constructed the Masso Reservoir in the early 1940's for use as a potable water reservoir. It was abandoned in 1951 because siltation had made it unsuitable for water storage. In 1978, the Black Construction Company, working under contract to DAWR, cleared about two acres of the pond by removing the Phragmites grass. At that time, the retaining wall, spillway and sluice gate were repaired. The pond was stocked numerous times with red hybrid tilapia (Oreochromis mossambica X O. nilotica), tucunare or "peacock bass" Chichla ocellaris and mosquito fish (Gambusia sp.) at a rate to keep a natural balance in the reservoir. Because of poaching, poisoning, and vandalism, the project was discontinued. We are planning to revive the project because the DAWR has increased it's enforcement staff and is now able to use fish restoration funds for "put and take" fishing.

OBJECTIVES

1. To conduct an assessment of fauna, habitat, and facilities on the old Masso Reservoir project site.
2. To utilize the assessment information and review the original project plant to develop a scope of work to restore the Masso Reservoir Project.
3. Initiate engineering consultations.

RESULTS

The scope of the Masso Reservoir Project has been amended to include the condition of the facilities on site and consideration to improve the old project plan. To accomplish this, a number of things have been done. Numerous trips were made to the reservoir to check on the status of the facilities and to become familiar with the project site. The manufacturer of the existing sluice gate has been identified and contacted to gather repair information. We have had numerous discussions in the office to reach a general consensus of project direction with ideas shared on ways to enhance the area for sport fishing.

DISCUSSION

Initially, plan implementation will place emphasis on deepening and enlarging the reservoir along with providing sediment traps. Next, the proposed plan may include fishing docks, shoreline fishing access points, floating islands for use by waterfowl, underwater structure for aggregating pond fish, small shelters for protection from the weather, a boat launching ramp with a gate to be used only for research, refurbishment of the water control sluice gate, a service road with slope reinforcement where appropriate, construction of an entrance parking lot with handicapped access, walk-thru gate and a sidewalk with a railing designed for the handicapped from the parking lot to the reservoir. Fencing and gates will be used to control public access in the area. There may be potential for nature trails, natural history interpretive signs and other displays made available to the public near the reservoir. Particular attention will be placed on evaluation of potential impacts to the endangered Marianas Common Moorhen. The project will be designed to be compatible with moorhen recovery and will include enhancement of available moorhen habitat.

The project will continue general plans for the dredging of the reservoir and construction of sediment traps to assist in submitting for bids to complete design plans. Once design plans have been completed and environmental clearances have been granted, the project will go out on bid for construction.

RECOMMENDATIONS

This program has valuable freshwater fishing application for Guam while providing a safety factor and enhancing fishing opportunities. Therefore, it is recommend that this job be continued in order to develop a freshwater reservoir on Guam for sport fishing.

PROGRAM COSTS

The estimated cost of the Masso Reservoir restoration project to date is \$3,325.

Report prepared by: Wayne Kruckenberg

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

JOB TITLE: Sea Turtle Monitoring Annual Report

PERIOD COVERED: October 1, 1992 to September 30, 1993

SUMMARY

During FY93 incidental to routine surveys, the shoreline waters and coastal beaches were monitored for sea turtle activity. During fifteen inshore aerial surveys, 156 sea turtles were surveyed. With the aid of the aerial survey and other beach observations, five nesting digs were identified, four by Green Sea Turtles and one by a Hawksbill Sea Turtle. Two of the four Green Sea Turtle digs were false crawls. Of the remaining two, one hatched successfully with 96 hatchlings while the other was destroyed by Typhoon Omar. The only Hawksbill nest hatched successfully with 87 hatchlings.

BACKGROUND

Historically, harvest of sea turtles eggs on Guam was more common prior to World War II. Green Sea Turtles were harvested legally on Guam prior to August 1978 when the Green Sea Turtle (*Chelonia mydas*) was listed as threatened under the Endangered Species Act. The Hawksbill Sea Turtle (*Eretmochelys imbricata*) has been listed as endangered since 1970. In an effort to ensure the protection of Sea Turtles on Guam, routine counts of sighting are taken during aerial survey and nest sites are recorded and monitored for hatchlings.

OBJECTIVE

To obtain and record as much information about activities on Guam pertaining to sea turtles.

PROCEDURES

Aerial surveys were conducted twice a month to identify fishermen and fishing areas, but incidental observations of turtles were also recorded. The single engine fixed wing aircraft plane flies between 300 and 500 ft in altitude and makes one counterclockwise pass around the island. Surveys are conducted in conjunction with randomly selected creel surveys which rotate through a series of hourly starting times ranging from 0800 to 1200. This survey was not designed for turtle observations and therefore the information is not always collected under ideal conditions. The data collected includes turtle numbers and the locations observed. Turtles are identified to species when possible but this is often not possible.

If turtle tracks were reported to DAWR or sighted on the aerial survey a beach inspection was conducted to determine if the crawl was a nesting event and if the nest contained eggs. If the nest contained eggs a determination of hatch time was estimated for confirmation of hatch. Records of number of hatchlings were recorded either by observation or counts of egg shells. Within a couple days of the hatch the nests were also dug out to check for turtles which may be trapped or eggs which did not hatch. Additionally, routine surveys of common nesting areas were conducted during the nesting season to check for potential nest sites which may have not been detected by other methods.

RESULTS

Fifteen inshore aerial flights and a number of beach visits were made during FY93. Nine inshore aerial surveys had to be cancelled due to poor flying conditions. The turtle species observed during the aerial surveys were Greens and Hawksbills. When comparing historical counts from aerial observations with two flights per month from 1975-79 versus 1992-93, the numbers seen are 783 turtles in 41 months (19 per month) and 100 turtles in 11 months (9 per month), respectively. These averages suggest that the turtle populations around Guam have declined. There is however an indication that the fluctuations may be more closely related to flight conditions and not necessarily a measure of population fluctuations. It is also not known how transient or seasonal the turtle population around Guam is and therefore it is not known specifically what these counts represent. Until the effects of these parameters can be analyzed it will not be appropriate to use this information as an abundance survey. It will however be useful for forage and habitat utilization indices.

NESTING SITES

Sea turtle nesting activity on Guam seemed particularly low during FY92. The cause of this is not known. The amount of monitoring on turtle nesting is not sufficient for a comprehensive survey of these events and it is therefore possible for a significant amount of nesting to occur without being detected. Accessibility to some areas and the difficulty in detecting tracks while on aerial flights also add to the data deficiency and accuracy of the present information.

OTHER SEA TURTLE ACTIVITIES AGENTS THREATENING SEA TURTLES ON GUAM

Habitat destruction continues to be the primary concern in conserving Guam sea turtles. Habitat destruction has been occurring mainly due to construction and development. This is also a function of insufficient information about the turtle activities specific to Guam which would allow the development of a more comprehensive plan for protection (foraging and nesting).

Another impact resulting from development and poor land management is sedimentation which has damaged coral reefs. This could have serious effects on the food sources for various turtles. With an increasing human population and continued rapid land development, the potential negative impacts to sea turtle foraging and nesting habitat continues to increase.

Predation is another impact which is difficult to assess. This includes illegal harvest by fishermen along with harvest by predators on nests. We do not have much of a problem with predation of hatchlings by birds but there have been observations of crab predation. Incidental catch does occur (illegal fishing in the EEZ and accidental gillnet capture along certain beaches) but the degree of this impact is not known. The large amount of longline fishing for tuna done just outside Guam's EEZ poses a potential major threat to the turtles if catchable by this manner of fishing. There are also neighboring countries which do not prohibit turtle harvest like Palau and the Philippines which impact overall Western Pacific turtle numbers.

RECOMMENDATIONS

1. Establish a protocol for regulating beach use in valuable turtle nesting areas. This is particularly true for Northern Guam where significant vehicle use on valuable turtle nesting beaches has been observed.
2. Since most of Guam's beaches are expected to have been sea turtle nesting beaches at one time it is now apparent human impacts have reduced the number of nesting beaches on Guam significantly. It is recommended that this project be formalized and expanded to gather more extensive site specific nesting information. Since the nesting cycle can take as long as seven years it is recommended that a thorough effort to identify nesting beaches be implemented over a seven year period. The present survey technique can provide important information in the design of such a survey but in no way should be considered extensive enough to provide accurate full coverage of the island-wide nesting activities. Given the rapid development of Guam, waiting to implement such a project only adds to the areas which will no longer be used. If the merits of such a project are approved, funding and staff will need to be pursued to implement and complete this project.

Report Prepared by Gerald W. Davis

GUAM COMMERCIAL FISHERIES

STATE: Territory of Guam

JOB TITLE: Commercial Fisheries on Guam

PERIOD COVERED: October 1, 1992 to September 30, 1993

SUMMARY

Commercial landings of locally caught fish are an important component of our total fisheries catch. The troll (pelagic) caught fish continue to make up the majority of the total fish landed by weight. Reef fish, bottom fish, imported fish, other fish and invertebrates made up a smaller portion of the catch. The data for this fiscal year has been sent to NMFS in Hawaii for processing. The summary data is available from NMFS or our office.

BACKGROUND

The Commercial Fisheries Program was established to monitor the fishery resource being caught and sold on Guam. In the past, the National Marine Fisheries Service (NMFS) has been collecting data only from the Guam Fishermen's Cooperative in Agana. Because it's been difficult for NMFS to handle the logistics of the program indirectly from Hawaii, the Division of Aquatic and Wildlife Resources has assisted directly with the program since January, 1990.

OBJECTIVES

To monitor, analyze and report on locally caught fish sales and related activities through the collection of vendor receipts.

PROCEDURES

There are three cooperating vendors presently providing receipt data to the program. The Guam Commercial Fisheries receipt books are provided to each vendor in the program. Each receipt asks for information to be completed by each cooperating vendor while the catch is being purchased. On each receipt, there is a space provided for the name of the person providing the catch, fisherman number, date, number of fishermen, hours fished, fishing location and fishing method. The fishing location number and fishing methods code are determined by using the chart included on the inside of each receipt book cover. The catch information is broken down into six primary areas: (1) Bottom fish, (2) Reef fish, (3) Troll (pelagic) fish, (4) Invertebrates, (5) Seaweeds, and (6) Imported Items. Each item has a code number to identify the fish, invertebrate, or seaweed. Space is provided to indicate the number of items, total weight, price paid per pound, the value of the items, the total value of the transaction and any additional remarks about the transaction. There are three copies of each receipt with one for the person representing the catch, one for the vendor, and one for processing the information into the computer data base.

The vendors were visited on a regular basis to monitor the completion of the forms, collect completed receipt books, check data completion and insure that they had a supply of receipt books. A log book was used to record when a receipt book was initially given and received back from a vendor. When a receipt book was returned, the name of the vendor was indicated on the outside at the top to indicate which vendor completed the receipt book.

The receipt books were transmitted to the NMFS office at Hawaii for data processing and sent back.

RESULTS

During FY93, 57 receipt books were collected from the cooperating vendors and processed at Hawaii. Summary data was sent back to us with monthly and year end totals. The data is presented in the "Fishery Statistics of the Western Pacific" and the bottom fish and pelagic plan monitoring team annual reports.

DISCUSSION

Since the initiation of the commercial fisheries program, our responsibilities have slowly increased. When the program was established locally, we received receipt books from the NMFS in Hawaii. Presently, the receipt books are printed on island. We have slowly increased our quality control with the receipt books to insure that the data and information on each receipt is correct. Each receipt is coded with a number according to who made the transaction with the vendor. We either code and/or double check the code numbers for the vendor that codes their own receipts. In addition, we have been more active to check out mistakes in the calculations and ask the vendors for the correct data. This way the staff in Hawaii can keypunch correct data. This has been done because of the errors found in the data by NMFS that could have been corrected and verified here. Hopefully, this method can be further refined to reduce the number of errors that have to be dealt with in Hawaii and reconfirmed here.

During the year, one of the cooperating vendors discontinued providing data to the program because of a management problem at the business. In addition, most of the fish sold were imported. The other two cooperating vendors were able to provide data for the complete fiscal year.

Our initial intent was to analyze the summary data received from Hawaii. Because the quality control of the data takes up most of our available time at the office, further analysis of the data locally has been put on indefinite hold. The summary data can be obtained in the "Fishery Statistics of the Western Pacific" published annually by the National Marine Fisheries Service in Honolulu, Hawaii or by contacting our office.

At this time, the cooperators with the commercial fisheries program are voluntary. We feel that we are covering about 75% of the locally caught fish sold on Guam. We are not covering imported frozen fish and the many roadside vendors along the hi-way that are importing fish from the Philippines and/or Micronesia. The primary goal of the program is to gather as much information as we can about our fisheries resource and have the collected data represent a complete picture of the locally caught and sold fish.

RECOMMENDATIONS

1. A law or regulation be passed that would require that people use an identification number in selling their catch to vendors and for vendors of local fish products to use our commercial fisheries receipts in their business transactions. This would give a more comprehensive view of the commercial fisheries activity around Guam. If such a law or regulation is passed, the person working directly with new vendors should be accompanied by a Conservation Officer until they use the receipts on a regular basis with no hesitation and/or resistance.

Report prepared by: Wayne Kruckenberg

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: W-1 R-1
SUB-PROJECT NO.: W-1
STUDY NO.: 1
JOB NO.: 1

JOB TITLE: Determination of Current Population Size and Distribution of Guam Deer (1460)

PERIOD COVERED: October 1, 1992 to September 30, 1993

SUMMARY

Population trend data obtained from spotlight counts on Andersen Air Force Base (AAFB) indicated no significant change ($p > 0.05$) in deer numbers, while Naval Magazine (NAVMAG) recorded a significant increase ($p < 0.001$).

BACKGROUND

The Guam deer (*Cervus mariannus*) has been under investigation by the Division of Aquatic & Wildlife Resources (DAWR) since 1961. Its distribution, population trends, and biology have been described by Wheeler (1979). Deer hunting statistics have been compiled since 1968 through hunter reporting procedures. The regular deer season is October 1 through December 31 with a bag limit of one antlered deer (buck only) per season per license holder exclusive of any special hunt harvest. The Director of Agriculture can authorize a special either-sex hunt to thin a particular herd in situations where the population presents a threat to life and property and to prevent damage to other natural resources from over grazing.

OBJECTIVES

To determine the current size and distribution of the deer population of Guam and to monitor population trends.

PROCEDURES

1. Continue spotlight counts on AAFB at 21 counts per year: 4 per month in May - July and one per month in other months.
 - a. Record number, age, sex and group composition.
 - b. Statistically analyze count data and compare with past data to discern population trends.
2. Continue monthly spotlight counts on NAVMAG with periodic spotlight counts in other areas.
3. Collect hunting statistics via a hunter questionnaire. Analyze statistics for changes in hunter kill, effort, and hunting location.

4. Collect biological data from carcasses killed during regular season and special hunts or from incidental sources such as road kills or confiscated animals.

RESULTS

Deer Hunting Statistics

Total license sales increased 38% during FY93, with 819 sold during the year. The increase in license sales can possibly be attributed to the increase in the number of Conservation Officers enforcing Guam wildlife laws and regulations.

Records of hunting activity and harvest are kept at Naval Computer and Telecommunications Area Master Station (NCTAMS) and AAFB during the regular season and special hunts (Table 1). According to hunter logs, 336 hunter-days (772 hunter-sorties) were expended on NCTAMS and resulted in the harvest of 12 deer.

Table 1. Hunter effort and deer take based on official hunter logs from Naval Computer and Telecommunications Area Master Station (NCTAMS) and Andersen Air Force Base (Northwest Field, bow areas on the main base, and a special hunt in the Conventional Weapons Storage Area [CWSA]) during FY93.

	Oct	Nov	Dec	Sept	Total
NCTAMS					
No. of hunter sorties	193	154	236	189	772
No. of hunter days (8-hr)	79	63	107	87	336
Deer taken	1	4	5	2	12
Days effort per take	79.0	15.7	21.4	43.5	28.0
Andersen Air Force Base					
Northwest Field					
No. of hunter sorties	372	429	511	656	1968
No. of hunter days (8-hr)	177	195	236	308	917
Deer taken	9	13	13	18	53
Days effort per take	19.7	15.0	18.2	17.1	17.3
Bow Areas on Main Base					
No. of hunter sorties	43	45	62	201	351
No. of hunter days (8-hr)	12.9	14.1	21.8	92.9	142
Deer taken	1	0	0	2	3
Days effort per take	12.9	-	-	46.4	47.3
CWSA					
No. of hunter sorties	89	110	80	116	395
No. of hunter days (8-hr)	45	54.5	37.8	62	199
Deer taken	0	0	0	0	0
Days effort per take	-	-	-	-	-

According to AAFB hunter logs, 917 hunter-days (1968 sorties) were expended Northwest Field (NWF) with 53 deer killed. Bow areas on the main base recorded 142 hunter-days (351 hunter-sorties) with three deer taken. The Conventional Weapons Storage Area (CWSA) recorded 199 hunter-days (395 sorties) with no deer killed during a special hunt.

Spotlight Count Trends

The average number of deer seen per count on AAFB decreased slightly to 57.3 in FY93 from 60.4 deer in FY92 (Table 2). The numbers observed throughout the entire year were not statistically different from those recorded the previous year (Mann-Whitney U-Test, $U = 80$, $n_1=12$, $n_2=12$, $p > 0.05$). The largest single nightly count during FY93 was 90 deer recorded in March, compared to 99 deer in 1992.

Table 2. Composition of deer herd during FY93 spotlight counts at AAFB, Guam. (Ave = Average, SD = Standard Deviation)

	1992			1993											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total	Ave	SD
Unclassed buck	2	0	2	0	1	1	0	1	1	1	3	1	13	1.1	0.9
Spike	0	1	1	2	1	1	0	0	0	0	2	0	8	0.7	0.8
2pt	1	5	1	2	1	2	1	0	1	1	2	0	17	1.4	1.3
3pt	0	1	1	1	0	4	0	0	2	1	3	2	15	1.3	1.3
4pt	0	0	1	0	0	0	1	0	0	0	0	1	3	0.3	0.5
Doe	11	12	23	21	31	37	35	15	27	25	28	26	291	24.3	8.4
Yearling	3	3	9	4	9	9	9	3	7	8	7	9	80	6.7	2.6
Fawn	1	0	1	0	0	0	0	0	1	5	3	0	11	0.9	1.6
Unclassed-deer	10	21	11	26	18	36	10	11	38	21	24	23	249	20.8	9.5
Total	28	43	50	56	61	90	56	30	77	62	72	62	687	57.3	18.1
Miles	4.5	4.0	4.0	4.6	4.4	4.2	5.0	4.5	4.0	5.0	3.0	4.0	2168		
Km	7.2	6.4	6.4	7.4	7.0	6.7	8.0	7.2	6.4	8.0	4.8	6.4			
Deer/10 mi	62.2	107.5	125.0	121.7	138.6	214.3	112.0	66.7	192.5	124.0	240.0	155.0	138.3		-
Deer/10 km	38.9	67.2	78.1	76.1	86.6	133.9	70.0	41.0	120.0	77.0	149.0	96.9	86.0		33.8

Deer numbers observed on spotlight counts at NAVMAG during FY93 were significantly higher (Mann Whitney U-Test, $U=130$ $n_1=11$, $n_2=12$, $p < 0.001$) than the previous year. The average number of deer seen per count increased to 71.4 deer in FY93 (Table 3) from 33.5 deer in FY92. The largest single nightly count increased to 98 deer in FY93, compared to 57 deer in FY92.

Table 3. Composition of deer herd during FY93 spotlight counts at Naval Magazine, Guam.

	'92			'93											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total	Ave	SD
Unclassed buck	1	1				4	1				3	1	11	1.8	1.33
Spike		2	3	3	2	2	1	1	2	4			20	2.2	0.97
2pt	1	2	2	2	2	3		2	1	2	2		19	1.9	0.57
3pt	2	7	2	7	2	2	2	2	4	6	6	4	46	3.8	2.12
4pt				4		1	1	1	2	0		1	10		
Doe	28	42	29	41	29	37	33	1	45	41	33	34	393	32.8	11.48
Yearling	10	13	6	6	5	3	9	28	14	7	12	7	120	10.0	6.59
Fawn	2	1		1	2	3	1	7		1	13	12	43	4.3	4.69

Unclassed deer	21	19	16	23	16	16	12	2	30	12	12	16	195	16.3	6.89
Total	65	87	58	87	58	71	60	44	98	73	81	75	857	71.4	15.32
Miles traveled	14.8	15	15	14.7	14.8	14	15	15	15	14	16	15	178.3	14.9	
Km traveled	23.8	24.1	24.1	23.7	23.8	22.5	24.1	24.1	24.1	22.5	25.7	24.1	286.9	23.9	
Deer/10 mi	43.9	58.0	38.7	59.2	39.2	50.7	40.0	29.3	65.3	52.1	50.6	50.0	577.1	48.1	10.25
Deer/10 km	27.3	36.0	24.0	36.8	24.4	31.5	24.9	18.2	40.6	32.4	31.5	31.1	358.6	29.9	6.37

RECOMMENDATION

Continue spotlight counts at present intensity at NAVMAG and AAFB. Collect biological data from carcasses as available.

PROGRAM COST

The estimated cost of this project under W-1R-1 is \$12,571.

LITERATURE CITED

Wheeler, M.E. 1979. The biology of the Guam deer. Tech. Rept. No. 3. Div. Aquatic and Wildl. Res., Dep. Ag., Mangilao. 53 pp.

Report prepared by: Celestino F. Aguon

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: W-1 R-1
SUB-PROJECT NO.: W-1
STUDY NO.: 2
JOB NO.: 2

JOB TITLE: Population Size and Distribution of Wild Pigs on Guam (1460)

PERIOD COVERED: October 1, 1992 to September 30, 1993

SUMMARY

Official logs recording harvest statistics for Andersen Air Force Base (AAFB) recorded a total hunting effort of 3983 hunter-sorties comprising 1810.3 hunter-days with a harvest of 291 pigs. Naval Computer and Telecommunication Area Master Station (NCTAMS) documented harvest statistics of 1196 hunter-sorties and a harvest of 39 pigs.

BACKGROUND

The wild pig (*Sus scrofa*) has long been an important natural resource on Guam and accounts for the greatest annual hunter recreation and harvest of all game animals. This species has been under investigation by the Division of Aquatic and Wildlife Resources (DAWR) since 1967 (Conry 1988). The wild pig on Guam is a descendant of domestic *Sus scrofa* introduced by the Spanish from the Philippines between 1672 and 1685. Wild pigs are found island-wide but appear to be most numerous in the limestone forests of the north and the ravine forests of southern Guam. Pigs occur at high enough densities in many areas that rooting and wallowing damage are common in most forested areas and can be quite severe locally. Depredation of agricultural crops is also a problem, particularly so for farmers in southern Guam during the dry season. Controlling the effects of pig damage is recognized as an important measure to protect native forest and agricultural resources. Recreational harvest is the primary tool used to control pig numbers and current hunting regulations provide for a year-round season with bags limits of 2 pigs per day and 40 per year. There is a need to consider more liberal regulations to control pig populations island-wide and in localized areas.

OBJECTIVES

To monitor trends in pig population size and hunter participation and harvest.

PROCEDURES

1. Record pig sightings during deer spotlight counts, and observations of pigs or pig sign during other fieldwork.
2. Monitor hunter participation and harvest during the legal hunting season.

RESULTS

Total license sales increased 38% during FY93, with 819 sold during the year.

A record of hunting activity and harvest was kept at NCTAMS and AAFB (Table 1). Data for AAFB comes from two bow-only areas, the Conventional Weapons Storage Area (CWSA) and Andersen South, and the shotgun-only area at Northwest Field.

Table 1. Hunter effort and number of pigs taken based on official hunter logs from Naval Computer and Telecommunication Area Master Station (NCTAMS), Northwest Field, and Andersen Air Force Base during FY93.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
NCTAMS													
No. hunter sorties	193	154	236	80	27	90	81	81	70	109	78	189	1196
No. hunter days (8-hr)	79.0	62.9	107.0	35.8	9.4	37.4	35.0	35.0	30.1	48.0	30.9	87	519.5
Pigs taken	2	2	7	3	2	5	2	2	3	7	4	2	39
Days effort/take	39.5	31.5	15.3	11.9	4.7	7.5	17.5	17.5	10.0	6.9	7.7	43.5	13.3
ANDERSEN AFB													
Northwest Field													
No. Hunter Sorties	372	429	511	64	24	73	29	55	77	81	109	656	2480
No. hunter days (8-hr.)	177	195	236	27.4	9.75	28.4	9.75	21.5	29.9	33.9	45	308	1122.0
Pigs taken	6	14	13	9	2	6	6	8	5	7	12	24	112
Days effort/take	29.5	13.9	18.2	3.0	4.9	4.7	1.6	2.7	6.0	4.8	3.8	12.8	10.0
Bow Areas of Main Base													
No. Hunter Sorties	43	45	62	45	19	49	22	42	36	45	37	201	646
No. hunter days (8-hr)	12.9	14.1	21.8	16.8	12.1	16.4	7.38	15.9	13	18.3	13.5	92.9	254.9
Pigs taken	7	2	4	7	5	10	6	9	5	8	4	11	78
Days effort/take	1.8	7.1	5.4	2.4	2.4	1.6	1.2	1.8	2.6	2.3	3.4	8.4	3.3
CWSA													
No. Hunter Sorties	89	110	80	62	4	91	45	33	70	65	92	116	857
No. hunter days (8-hr.)	45	54.5	37.8	34	2	47.8	22.4	17	30.6	33.9	46.5	62	433.4
Pigs taken	15	9	5	10	0	10	9	6	10	9	12	6	101
Days effort/take	3.0	6.1	7.6	3.4	0.0	4.8	2.5	2.8	3.1	3.8	3.9	10.3	4.3

Based on hunter logs, Northwest Field recorded 1122.0 hunter-days (2480 hunter-sorties) and resulted in the harvest of 112 pigs (Table 1). Bow areas recorded 254.9 hunter-days (646 hunter-sorties) and resulted in the harvest of 78 pigs. CWSA recorded 433.4 hunter-days (857 hunter-sorties) and resulted in the harvest of 101 pigs.

When logs of FY92 were compared to FY93 (DAWR 1992), Northwest Field recorded a 53% decrease in the number of pigs harvested from 246 to 112 pigs. The number of hunter-days decreased 8% from 1219.6 to 1122.0 hunter-days. Bow areas recorded a decrease in hunting activity, with an 18% drop in the number of hunter-days and a 34% drop in the number of pigs harvested. CWSA recorded an increase in hunter-days of 43% and a decrease of 29% in the number of pigs taken.

The record of hunting activity from NCTAMS indicated that 1196 hunter-sorties were expended on NCTAMS and resulted in the harvest of 39 pigs, a 17% decrease compared to last year.

RECOMMENDATIONS

Continue to monitor the annual pig harvest and hunter participation. Coordinate accurate record keeping and reporting of hunter effort and harvest at military bases.

PROGRAM COST

The estimated cost of the project under W-1R-1 is \$12,571.

LITERATURE CITED

Conry, P. J. 1988. Ecology of the wild (feral) pig (*Sus scrofa*) on Guam. Tech. Rept. No. 7. Div. Aquatic and Wildl. Res., Dep. Ag., Mangilao. 60 pp.

Division of Aquatic and Wildlife Resources. 1992. Job Progress Report - Federal Aid to Fish and Wildlife Restoration. Guam Dept. of Agriculture.

Report prepared by: Celestino F. Aguon

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: W-1 R-1
SUB-PROJECT NO.: W-2
STUDY NO.: 1
JOB NO.: 1

JOB TITLE: Population Numbers and Distribution of Philippine Turtle-Doves (1460)

PERIOD COVERED: October 1, 1992 to September 30, 1993.

SUMMARY

The spring game bird survey conducted this year showed no change in the relative abundance of Philippine turtle-doves (*Streptopelia bitorquata*) over last year's count. However, counts in the Conventional Weapons Storage Area (CWSA) showed a significant increase in numbers ($p < 0.05$). Northwest Field (NWF) increased slightly but not significantly.

BACKGROUND

The Philippine turtle-dove was introduced to Guam by the Spanish during their early colonization of the region, circa 1771 (Baker 1951), and has been regulated as a game bird since at least 1903 (Conry 1987). Up through the early 1960s, the turtle-dove was very common and found in large numbers in both northern and southern Guam. By the late 1960s, dove populations in southern and central Guam began to decline and have since stabilized at low levels. Populations in northern Guam declined in the late 1970s and early 1980s. Turtle-doves are now found in appreciable numbers in prime dove habitat on NWF, CWSA and elsewhere on Andersen Air Force Base (AAFB) and at moderate numbers in selected areas of central and southern Guam. A large population still remains on snake-free Cocos Island. Predation by the brown tree snake (*Boiga irregularis*) is the major cause of nest loss (Conry 1988) and this introduced pest is thought to be responsible for the population decline. Because of the decline in numbers and the extremely poor nesting success, the Department of Agriculture officially closed the turtle-dove hunting season as of March 28, 1987. The season will be reopened if nesting success improves and numbers recover to a level that can support recreational hunting.

OBJECTIVES

1. To determine present population levels and distribution, and monitor population trends.
2. To investigate nesting success and causes of nest failures.

PROCEDURES

Call-count and roadside-count surveys were conducted at NWF and the CWSA, AAFB. Both surveys were conducted once to twice monthly in early morning. The call-count survey consisted of counting the number of doves seen or heard during a 5-minute period at 10 stations in NWF, plus the number of doves seen enroute between stations. The

survey at CWSA involved counting the number of turtle-doves seen while driving at 25 km per hour along an established 32-km route.

Turtle-doves were also surveyed during spring game bird counts conducted on 23 routes throughout the island in June. These surveys consisted of 5-minute station counts at up to 10 stations per route, with the number of birds seen or heard recorded at each station. Results are summarized as the average number of birds observed per station.

Philippine turtle-doves are also included in a twice monthly roadside-count of all birds conducted by DAWR conservation officers in 3 areas of northern Guam. The results of these surveys are reported in Job W-1-3.

RESULTS

Population Surveys

Call count surveys and roadside counts were continued at NWF and the CWSA (Table 1). Surveys on NWF increased over the previous year, but not significantly (Mann-Whitney U-Test, $n_1 = 1$, $n_2 = 1$, $U = 77$, $p > 0.05$). The average count increased 34% from 7.4 birds/survey in FY92 to 9.9 birds/survey in FY93. Roadside counts in the CWSA increased significantly over last year's counts (Mann-Whitney U-Test, $n_1 = 13$, $n_2 = 15$, $U = 181$, $p < 0.001$). The average count per survey increased 38% from 10.5 birds/count in FY92 to 14.5 birds/count in FY93.

Table 1. Results of Philippine Turtle-Dove surveys at Northwest Field (NWF) and the Conventional Weapons Area (CWSA) on Andersen Air Force Base, Guam during FY93.

	NWF Surveys	CWSA Surveys
1992		
October	9	13
November	8	5
December	6	17
1993		
January	10	14
February	No Data	No Data
March	13	16
April	14	22
May	6	8
June	3	20
July	18	22
August	5	11
September	17	12
Survey Average	9.9	14.5

Spring Game Bird Surveys

Turtle-doves were recorded on 21 of 23 spring game bird surveys conducted in 1993 (Table 2). Snake-free Cocos Island remains the highest count on the island by far, with an average of 3.3 birds observed per station. Mt. Santa Rosa and Cocos Island are the only routes which had station counts of ≥ 1.0 birds/station. There was no significant change from last year's survey (Wilcoxon Signed-rank Test, $Z = -0.82$, $p > 0.05$).

Table 2. Numbers of Philippine Turtle-Doves detected per count and average number of birds per station on spring game bird surveys at various locations on Guam during May 1993. Values in the trend column are the difference between the average station count between years.

Survey location	No. stations	No. doves observed	1993 ave. per station	1992 ave. per station	Trend in ave. 93-92
Tarague	10	6	0.60	0.40	0.20
CWSA	10	8	0.80	0.90	-0.10
NWF	10	6	0.60	1.20	-0.60
NCTAMS	10	5	0.50	0.40	0.10
Capitol Improvement Rd.	10	4	0.40	0.30	0.10
Mt. Santa Rosa	10	12	1.20	1.60	-0.40
Y-Sengsong Road	10	6	0.60	0.30	0.30
Two Lovers Point	10	0	0.00	0.30	-0.30
Andersen South	10	2	0.20	0.50	-0.30
Navy Golf Course Barrigada	10	9	0.90	0.60	0.30
Barrigada Hill	10	3	0.30	0.50	-0.20
Toto Pipeline	8	1	0.13	0.00	0.13
Nimitz Hill	10	3	0.30	0.40	-0.10
Reserve Craft Beach Road	4	2	0.50	0.50	0.00
Orote Point	6	4	0.67	0.00	0.67
Pulantat	10	4	0.40	0.10	0.30
Cross Island Road	10	2	0.20	0.40	-0.20
Naval Magazine	10	5	0.50	0.60	-0.10
Umatac	10	2	0.20	0.20	0.00
Dandan	10	1	0.10	0.50	-0.40
Ija	8	0	0.00	1.00	-1.00
Merizo	8	5	0.63	0.10	0.53
Cocos Island	10	33	3.30	5.20	-1.90

RECOMMENDATIONS

1. Continue call count and roadside count surveys in northern Guam to monitor distribution, relative abundance and population trends of the Philippine turtle-dove.
2. Keep the turtle-dove hunting season closed until nesting success improves and the population recovers.

PROGRAM COST

The estimated cost of the Philippine turtle-dove project under W-1R-1 is \$10,788.

LITERATURE CITED

- Baker, R.H. 1951. The avifauna of Micronesia, its origin, evolution, and distribution. University of Kansas Pub. 3(1):1-359.
- Conry, P. J. 1987. Ecology of the Philippine Turtle-Dove on Guam. Tech. Report No. 6. Div. Aquatic and Wildl. Res., Dep. Ag., Mangilao.
- Conry, P. J. 1988. High nest predation by brown tree snakes on Guam. Condor 90:478-482.

Report prepared by Celestino F. Aguon

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: W-1 R-1
SUB-PROJECT NO.: W-2
STUDY NO.: 2
JOB NO.: 1

JOB TITLE: Population Size and Distribution of Black Francolin on Guam (1460)

PERIOD COVERED: October 1, 1992 to September 30, 1993

SUMMARY

Black francolin (*Francolinus francolinus*) occurred on 15 of 23 spring game bird survey routes conducted throughout Guam. Fourteen survey routes had decreases in the numbers of francolin, 5 routes had increases of 1 or more birds, and 6 routes showed no change from last year. This pattern of change was statistically significant ($p < 0.001$) compared to FY92 counts. This species appears able to sustain the current levels of recreational hunting.

BACKGROUND

In 1961, 171 black francolin were introduced in southern Guam as part of the Foreign Game Bird Introduction Program of the U.S. Fish and Wildlife Service. Surveys conducted in 1980 indicated the population was adequately established in most parts of southern Guam to open a hunting season. Regulations were promulgated to open a 1-month season in December 1981 with a 4-bird daily limit and a 20-bird season limit. Francolin populations continued to increase from 1980-1982, but hunting pressure remained low, probably because of the unfamiliarity of the hunting public with the sporting qualities of the bird. With the bird population consistently increasing and little hunting pressure, the francolin season and bag limits were further liberalized in FY83 to a 2-month-split season, 1 month in January and 1 month in July, and the bag limit was increased to 5 birds per day with no season limit. Revisions to the francolin season were again made in FY90 extending the season from January 1 to February 28 and from July 1 to August 31. Francolin hunting has increased in popularity and Guam hunters are successfully harvesting birds during the open seasons. Regulations implemented in FY83 remain in effect with hunter participation and adherence to game laws monitored by spot checks by Division of Aquatic and Wildlife Resources (DAWR) biologists and conservation officers.

OBJECTIVES

To determine current relative abundance and distribution of black francolin on Guam and to monitor population trends and hunter harvest.

PROCEDURES

1. Conduct annual island-wide spring game bird surveys (station counts) to monitor distribution and status of francolin throughout the island.
2. Conduct twice weekly station-count surveys during May-June to monitor pre hunting season status of francolin population in Dandan, Inarajan.

3. Monitor hunter harvest via an annual harvest questionnaire. Collect information on hunter participation, effort, harvest, and areas hunted.

RESULTS

Francolin Hunting Statistics

Total license sales increased 38% during FY93, with 819 sold during the year. Because of manpower constraints, harvest questionnaires for last year (FY92) were not mailed out. Questionnaires for FY93 will be included in next year's (FY94) report.

Spring Game Bird Surveys

Black francolin were detected on 15 of 23 spring game bird surveys during May 1993 (Table 1). Francolin were found on 9 of 11 surveys south of Route 4. Birds were present on 6 of 11 routes in northern Guam, which is no change from last year's tally.

Table 1. Numbers of black francolin detected per count and average number of birds detected per station on spring game bird surveys at various locations on Guam during May 1993. Values in the trend column are the difference between the average station count between years.

Survey Location	No. Stations	No. Birds Detected	1993 Ave./ Station	1992 Ave./ Station	Trend in Average 93-92
Tarague	10	0	0.00	0.00	0.00
CWA	10	0	0.00	0.00	0.00
NWF	10	1	0.10	0.00	0.10
NCTAMS	10	9	0.90	0.30	0.60
Capital Improvement Road	10	0	0.00	0.00	0.00
Mt. Santa Rosa	10	0	0.00	0.10	-0.10
Y Sengsong Road	10	0	0.00	0.00	0.00
Two Lover's Point	10	23	2.30	0.80	1.50
Andersen South	10	1	0.10	0.20	-0.10
Navy Golf Course Barrigada	10	29	2.90	2.40	0.50
Barrigada Hill	10	23	2.30	0.90	1.40
Toto Pipeline	8	0	0.00	0.00	0.00
Nimitz Hill	10	20	2.00	1.90	0.10
Reserve Craft Beach Road	4	0	0.00	1.00	-1.00
Orote Point	6	11	1.83	0.33	1.50
Pulantat	10	48	4.80	3.90	0.90
Cross Island Road	10	38	3.80	3.30	0.50
Naval Magazine	10	51	5.10	3.80	1.30
Umatac	10	50	5.00	4.40	0.60
Dandan	10	32	3.20	2.30	0.90
Ija	8	34	4.25	4.00	0.25
Merizo	8	43	5.38	2.10	3.28
Cocos Island	10	0	0.00	0.00	0.00

The Merizo survey route had the highest station counts this year, with an average of 5.38 birds/station (Table 1). Merizo also recorded the greatest increase in birds at 3.28 birds/station. The average number of birds detected per station increased on 14 survey

routes and decreased on 3, as compared to 1992 (DAWR 1992). This was a statistically significant (Wilcoxon Signed-rank Test, $Z = -2.822$, $p < 0.001$) pattern of change in the data between this year and last year. Francolin populations remain well established and stable throughout southern Guam and in shrub-grass habitats in central and northern Guam.

RECOMMENDATIONS

1. Continue to monitor francolin population status, distribution, and hunter harvest.
2. Increase the response rate of annual hunter questionnaire.

PROGRAM COST

The estimated cost of the black francolin project under W-1R-1 is \$10,542.

LITERATURE CITED

Division of Aquatic and Wildlife Resources. 1992. Job Progress Report. Federal Aid to Fish and Wildlife Restoration. Div. Aquatic and Wildl. Res., Dep. Ag., Mangilao.

Report prepared by Celestino F. Aguon

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO: W-1 R-1
SUB-PROJECT NO.: W-3
STUDY NO.: 1
JOB NO.: 1

JOB TITLE: The Status and Ecology of Wild Asiatic Water Buffalo on Guam (1460)

PERIOD COVERED: October 1, 1992 to September 30, 1993

SUMMARY

The abundance of wild (feral) Asiatic water buffalo (*Bubalus bubalis*) on the U.S. Naval Magazine showed an almost significant increase during FY93.

BACKGROUND

Spotlight counts of Asiatic water buffalo, known locally as carabao, on Naval Magazine were initiated in about 1966 by the Division of Aquatic and Wildlife Resources (DAWR). The size of the base's herd remained fairly constant from 1966-1978, averaging about 0.6-0.8 animals/km traveled during counts (Anderson 1980). Numbers began to increase in 1979 and peaked in 1982, with a mean of 2.6 animals/km (DAWR 1980-1982). Buffalo abundance declined thereafter, falling to a mean of about 1.5-1.7 animals/km during 1986-1988 (DAWR 1983-1988). In 1987, Biosystems Analysis Inc. (1989) estimated the population on the base to contain 75-150 animals. Counts increased to an average of 2.5 animals/km in 1989 (DAWR 1989), then declined to 1.4-1.8 animals/km for 1990-1992 (DAWR 1990-1992). Illegal hunting appears to be the major cause of mortality in the population (Conry 1988). High buffalo densities have resulted in localized habitat damage on Naval Magazine (Conry 1988, Biosystems Analysis Inc. 1989).

OBJECTIVES

To monitor the status of the wild Asiatic water buffalo population on Guam and determine if control measures are necessary to maintain the population at a level compatible with the available resources.

PROCEDURES

1. Conduct monthly spotlight counts on Naval Magazine. Analyze count data and compare with past data to estimate population trends.

RESULTS

The average number of water buffalo seen per spotlight count on Naval Magazine exhibited an almost significant increase from 1.7 animals/km in FY92 to 2.1 animals/km in FY93 (Mann-Whitney *U*-Test, $U=40.5$, $0.10 > P > 0.05$) (Table 1). The mean number of animals seen per count in FY92 was 49.9 animals. The largest number of water buffalo recorded on a monthly count decreased slightly from 70 animals in FY92 to 66 animals in FY93. No additional work to assess population parameters of the Naval Magazine herd was done during the year because limitations in manpower.

Table 1. Results of monthly spotlight counts of feral water buffalo at Naval Magazine, FY93.

Month	No. animals observed	Km traveled	Animals/ km	Miles traveled	Animals/ mile
Oct	49	23.8	2.1	14.8	3.3
Nov	37	24.2	1.5	15.0	2.5
Dec	30	24.2	1.2	15.0	2.0
Jan	47	23.7	2.0	14.7	3.2
Feb	64	23.8	2.7	14.8	4.3
Mar	50	22.5	2.2	14.0	3.6
Apr	56	24.2	2.3	15.0	3.7
May	43	24.2	1.8	15.0	2.9
Jun	49	24.2	2.0	15.0	3.3
Jul	66	22.5	2.9	14.0	4.7
Aug	46	25.8	1.8	16.0	2.9
Sep	62	24.2	2.6	15.0	4.1
Total	599	287.3	-	178.3	-
Ave	49.9	23.9	2.1	14.9	3.4
SD	10.77		0.49		0.77

RECOMMENDATIONS

Continue monthly spotlight counts of water buffalo at Naval Magazine. Additional aerial and ground surveys should be made as conducted in FY '89 (DAWR 1989). An investigation into the impacts of water buffalo on Naval Magazine's vegetation should be initiated. The construction of an enclosure on the base would help to evaluate damage to plant communities caused by browsing and wallowing. Other study activities should be expanded to obtain more biological information on diet, population characteristics, movements and general distribution, and causes of mortality.

PROGRAM COST

The estimated cost of the Asiatic water buffalo project under W-1R-1 is \$ 5,402.

LITERATURE CITED

- Anderson, R.D. 1980. Population size and distribution of wild carabao on Guam. Job Progress Report. Federal Aid to Fish and Wildlife Restoration, Guam. Guam Dept. Agric., Mangilao, Guam.
- Biosystems Analysis, Inc. 1989. Natural resources survey for the U. S. Naval Magazine, Guam (NavMag). Naval Facilities Engineering Command, Pearl Harbor, Hawaii.
- Conry, P.J. 1988. Management of feral and exotic game species on Guam. Trans. West. Sec. Wildl. Soc. 24:26-30.
- Division of Aquatic and Wildlife Resources. 1980-1992. Job Progress Reports. Federal Aid to Fish and Wildlife Restoration, Guam. Guam Dept. Agric., Mangilao, Guam.

Report prepared by: Gary J. Wiles

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: W-1 R-1
SUBPROJECT NO: W-4
STUDY NO.: 1
JOB NO.: 1

JOB TITLE: Survey and Inventory of Non-Game Birds (1460)

PERIOD COVERED: October 1, 1992 to September 30, 1993

SUMMARY

Monthly roadside counts for native forest birds, cave censuses for island swiftlets (*Aerodramus vanikorensis*), and surveys at Fena Reservoir for Mariana common moorhens (*Gallinula chloropus guami*) continue to document the population trends of Guam's birds. Roadside counts in northern Guam recorded two native forest birds (Micronesian starling, *Aplonis opaca*, and Mariana crows, *Corvus kubaryi*), two resident birds, one migratory shorebird, and four introduced birds. An average of 7.7 moorhens were recorded per count at Fena, with a high of 14 birds and low of 2 birds. Censuses of swiftlets at Mahlac Cave fluctuated from about 300 birds in February and March to about 425-450 birds from July to September. Two revealing observations provided evidence of snake predation at the cave. A count of 58 swiftlets was obtained at Fachi Cave, and another small colony was verified in the Lumuna area of Yigo, but its cave was not found. The annual Mariana crow survey estimated about 50 birds, which was no significant change from last year's survey. A program to control avian predators on Cocos Island resulted in the taking of 16 monitor lizards.

BACKGROUND

Since the early 1960s, census data has documented the decline in both range and numbers of Guam's native land birds. Roadside counts initiated in 1960 over four routes in southern, central and northern Guam by the Division of Aquatic and Wildlife Resources (DAWR) have provided an index to the decline (DAWR 1974-1992). From 1979-1981 population trends were monitored using variable circular-plot counts in central and northern Guam (DAWR 1980-1982). In 1981, an intensive forest bird survey was conducted by the U.S. Fish and Wildlife Service (USFWS) and the DAWR (Engbring and Ramsey 1984). Some of these transects used in 1981 were repeated from 1982-1988 by the DAWR (1982-1988). From 1963-1968, 54 monthly surveys were made at Fena Reservoir for moorhens. In 1987, monthly surveys at Fena were reinitiated and more regular surveys of other wetlands used by moorhens began. In 1987, surveys of island swiftlets were begun at the major remaining nest cave on Naval Magazine. Predation by brown tree snakes (*Boiga irregularis*) is the major factor contributing to the decline of Guam's native forest bird populations (Conry 1988; Savidge 1986, 1987).

Current distributions of native birds are as follows: Mariana crow, restricted to northern Guam with the center of distribution being Northwest Field (NWF), Conventional Weapons Storage Area (CWSA), and adjacent cliffines on Andersen Air Force Base (AAFB); island swiftlet, primarily eastern Naval Magazine and the Talofofo River Valley; common moorhen, found in wetlands in central and southern Guam; Micronesian starling,

found on AAFB, Cocos Island, the southern coasts of Guam, and downtown Agana; and the yellow bittern (*Ixobrychus sinensis*), found throughout the island (DAWR 1988-1992).

OBJECTIVES

To continue status surveys and natural history studies as called for in the recovery plans for Guam's endangered native birds (Beck and Savidge 1990, U.S. Fish and Wildlife Service 1991a, 1991b).

PROCEDURES

1. Roadside counts were conducted at bi-weekly intervals on three routes (North, North-Central, and NWF: see previous annual reports for locations of routes) in northern Guam by DAWR Conservation Officers. These routes were driven at approximately 6-9 kph beginning at sunrise. Numbers and species of all birds seen or heard were recorded, irrespective of the distance from the observer.
2. Monthly surveys for Mariana common moorhens were conducted at Fena Reservoir on Naval Magazine. Two or three observers paddled a canoe to the southern end of the reservoir before sunrise. The count began shortly after sunrise with the canoe paddled northward along the shorelines, into bays, and up tributaries. Locations of moorhens seen and heard were recorded.
3. Monthly counts of island swiftlets were conducted at Mahlac Cave on Naval Magazine. Observers sat at both entrances of the cave for a period of 1.5-2 hours before dark and recorded the numbers of birds flying in and out. The total number of birds inhabiting the cave was determined by subtracting the number of departures from the number of arrivals and by adding the number of birds estimated to be in the cave at the start of the count. Prior to each count, observers entered the cave for 0.5-1 hour to look for evidence of nesting and reproductive activity. The presence of nestlings and their calls and the incidence of adult birds that appeared to be incubating eggs or brooding young were noted. To avoid disturbing nesting birds, nests were viewed from a slightly elevated position off to the side of the cave rather than by lifting a mirror up to look inside the nests. The cave floor was searched and cleaned each month of eggshell fragments and whole eggs that had fallen from nests overhead.
4. Recorded-call playback surveys for Mariana crows were conducted in northern Guam. At each station, tape-recorded calls were played for 2.5 minutes. This was followed by a 2-minute silent period during which the observer listened for crows. The numbers, distance, and plumage condition of the crows observed were recorded.

RESULTS

Roadside counts continue to document the status of birds in the northern half of Guam. Tables 1, 2, and 3 present monthly count data for FY93. Table 4 summarizes the data for all three routes during the year. Seven species were observed on the North count (Table 1), which is one species more than in FY92. The common fairy tern (*Gygis alba*) was the additional species recorded in FY93.

Six species were observed on the NWF route (Table 2). Six Mariana Crows were observed compared to four last year. The Micronesian starling was observed on this route during the month of September. This is the first record of starlings on this route since 1986 (DAWR 1986). The yellow bittern, Philippine turtle-dove, and black drongo showed

decreases, while the Mariana crow and lesser golden plover increased when compared to FY92.

Table 1. The average number of birds observed each month on the North roadside counts during FY93.

Species	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr	May	Jun	Jul	Aug	Sep	Ttl	Cnt
Yellow Bittern	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	18	0.82
Black Francolin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	3	0.14
L. Golden Plover	10.0	14.0	13.0	9.0	25.0	7.5	18.5	0.0	0.0	0.0	0.0	13.5	212	9.64
C. Fairy Tern	0.0	0.0	12.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24	1.09
Phil. Turtle-Dove	1.5	1.0	0.0	0.0	0.0	8.0	1.0	0.5	0.0	4.0	0.0	0.0	28	1.27
Black Drongo	2.0	0.0	0.0	1.0	0.0	0.0	2.5	1.5	0.5	2.0	0.0	5.5	27	1.23
Eur. Tree Sparrow	0.0	1.0	0.0	3.0	2.0	12.5	2.0	7.5	11.0	7.0	0.0	2.0	86	3.91
Km traveled	75.64	79.02	80.47	37.66	62.76	73.23	75.64	77.25	77.25	39.27	80.47	78.05	836.7	
Miles traveled	47.00	49.10	50.00	23.40	39.00	45.50	47.00	48.00	48.00	24.40	50.00	48.50	519.9	
Counts	2	2	2	1	2	2	2	2	2	1	2	2	22	

Table 2. The average number of birds observed each month on the Northwest Field roadside counts during FY93.

Species	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr	May	Jun	Jul	Aug	Sep	Ttl	Cnt
L. Golden Plover	28.0	45.0	33.0	79.0	53.5	36.0	21.5	0.3	0.0	0.0	20.0	53.0	607	28.90
Phil. Turtle-Dove	4.0	2.5	4.0	7.0	1.5	3.5	3.0	5.0	3.0	7.0	10.0	1.0	80	3.81
Black Drongo	3.5	1.5	0.0	0.0	2.5	8.0	3.0	0.3	3.0	0.0	0.0	1.5	47	2.24
Mariana Crow	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	6	0.29
Micro. Starling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	2	0.10
Km	30.74	26.07	13.20	17.86	35.73	34.44	35.57	53.11	33.64	17.38	18.02	42.33	358.1	
Miles	19.10	16.20	8.20	11.10	22.20	21.40	22.10	33.00	20.90	10.80	11.20	26.30	222.5	
Counts	2.00	2.00	1.00	1.00	2.00	2.00	2.00	3.00	2.00	1.00	1.00	2.00	21.00	

Eight species were recorded on the North Central route (Table 3). The Micronesian starling was also recorded along this route in September. The yellow bittern, lesser golden plover, Philippine turtle-dove, and Eurasian tree sparrow decreased in abundance, while the black francolin and black drongo showed increases when compared to FY92 (Table 4).

Table 3. The average number of birds observed each month on the new North Central roadside counts during FY93.

Species	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr	May	Jun	Jul	Aug	Sep	Ttl	Cnt
Yellow Bittern	0.00	0.00	0.50	0.00	0.50	0.50	0.00	0.00	0.00	0.00	1.00	0.00	5.00	0.23
Black Francolin	0.00	0.00	0.50	3.00	0.50	6.50	1.50	10.50	13.00	7.00	2.50	1.50	83.00	3.77
L. Golden Plover	29.00	9.00	11.50	18.00	10.00	7.50	23.00	1.00	0.00	0.00	0.00	0.00	252.0	11.45
C. Fairy Tern	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	0.91
Phil. Turtle-Dove	3.50	1.50	2.50	0.00	2.00	3.00	0.50	0.50	1.50	1.00	4.00	1.00	41.00	1.86
Black Drongo	2.00	11.50	0.00	0.00	2.00	1.00	3.00	5.00	1.50	5.00	2.50	0.00	62.00	2.82
Micro. Starling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	1.00	0.05
Eur. Tree Sparrow	6.00	0.00	2.50	0.00	1.00	7.50	3.00	1.00	11.00	0.00	0.00	0.00	64.00	2.91
Km	42.00	38.62	38.62	20.92	39.27	41.36	40.56	39.43	39.91	20.92	38.79	44.26	444.7	
Miles	26.10	24.00	24.00	13.00	24.40	25.70	25.20	24.50	24.80	13.00	24.10	27.50	276.3	
Counts	2.00	2.00	2.00	1.00	2.00	2.00	2.00	2.00	2.00	1.00	2.00	2.00	22.00	

Table 4. Results of North, Northwest Field (NWF), and North-Central (NC) roadside counts showing the mean number of birds per 100 km of travel and the standard deviation (SD).

Species	North		NWF		NC	
	No/100 km	SD	No/100 km	SD	No/100 km	SD
Yellow Bittern	2.15	2.60	0.00	0.00	1.12	0.33
Black Francolin	0.36	0.39	0.00	0.00	18.67	4.38
Lesser Golden Plover	25.34	8.17	169.52	24.50	56.67	10.54
Common Fairy Tern	2.87	3.46	0.00	0.00	4.50	2.89
Philippine Turtle-Dove	3.35	2.40	22.34	2.59	9.22	1.27
Black Drongo	3.23	1.63	13.13	2.33	13.94	3.24
Mariana Crow	0.00	0.00	1.68	1.44	0.00	0.00
Micronesian Starling	0.00	0.00	0.56	0.58	0.22	0.14
Eurasian Tree Sparrow	10.28	4.40	0.00	0.00	14.39	3.63

Common Moorhens

In FY93, staff biologist Michael Ritter initiated and completed field research as partial fulfillment for a Master's degree at the University of Nebraska-Lincoln. This study examined the characteristics and use of 33 wetlands where moorhens had been recorded sometime in the last 20 years. Statistical comparisons of 19 variables were made between human-made and natural wetlands and seasonal and permanent wetlands, and combinations thereof. During this study, moorhens were recorded at 23 wetlands. The results of this study will be available in 1994.

A cooperative agreement was established between the U.S. Navy, USFWS and DAWR for the enhancement of the Camp Covington (Naval Station) wetland located at Apra Harbor. Small numbers of moorhen and waterfowl made seasonal use of the wetland in the past when considerably more open water habitats existed. A decline in avian use since 1988 is attributed to the encroachment of *Phragmites* spp. and *Panicum* spp. into the few remaining open water habitats.

An environmental assessment prepared by the USFWS and DAWR identified a 2-ha portion of this 40-ha wetland for enhancement through vegetation removal. The objectives are to provide additional open water habitats for moorhen and evaluate one method of vegetation control. At this time, the EA is in review, but the project may still be implemented in the upcoming dry season sometime in March or April 1994.

Monthly Mariana common moorhen surveys at Fena Valley Reservoir resumed in FY93. Surveys started shortly after sunrise and lasted an averaged 151 min (n = 14, range = 90 - 200 min). The majority of the surveys (n = 11) lasted between 120 - 180 min. All birds seen and heard were recorded. Count data and water levels are summarized in Table 5. Surveys averaged 7.7 moorhens, with dry season counts at the beginning of the year slightly higher than wet season counts (Fig. 1). Seventy percent (76 of 108) of all birds were recorded in the extreme southern end of the reservoir where shallower water provides some areas for emergent vegetation to become established.

Table 5. Summary of monthly counts of Common Moorhens at Fena Valley Reservoir between November 1992 and November 1993.

Date	Adult	Juvenile	Chicks	Unknown	Total	Nests	Water Level
11/6/92	0	0	0	3	3	0	112'
12/11/92	0	0	0	4	4	0	112'
1/12/93	1	0	0	1	2	0	110'
2/5/93	12	0	0	0	12	0	108'
3/5/93	5	0	0	4	9	1	106'
4/14/93	11	0	0	0	11	0	100'
5/7/93	13	0	0	1	14	0	95'
6/9/93	5	0	0	1	6	0	90'
6/16/93 ^a	9	0	0	0	9	0	88'
7/13/93	5	0	0	5	10	0	82'
8/13/93	3	0	4	3	10	0	82'
9/15/93	4	1	0	3	8	0	87'
10/13/93	5	3	0	0	8	0	107'
11/10/93	2	0	0	0	2	0	109'

^a A second survey was conducted in June because of equipment problems and feral dogs encountered during the regularly scheduled survey.

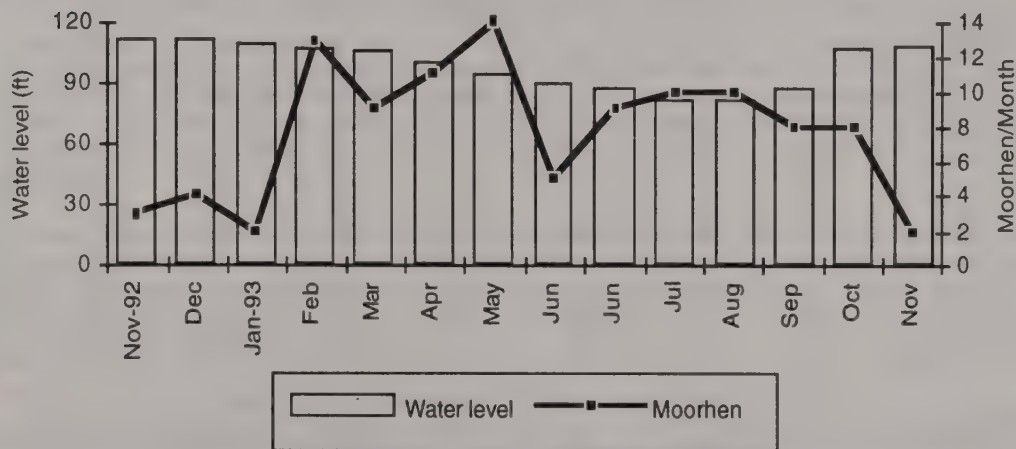


Figure 1. Total number of Mariana Common Moorhens and water level recorded each month at Fena Valley Reservoir between November 1992 and November 1993.

Feral dogs were seen or heard on counts in May, June, and September. Up to three dogs were seen at one time. Dog tracks and trails occurred frequently on exposed flats at the south end of the reservoir in the dry season. This is the same area where most moorhens were recorded.

Ritter and Sweet (1993) documented moorhen use of a created wetland at Manengon Hills Resort in Yona. The number of created and enhanced wetlands on Guam is expected to

increase as other resorts and golf courses are developed. These wetlands may provide additional sites for moorhens and contribute to recovery objectives listed in the moorhen recovery plan (USFWS 1992).

Native Doves

No observations of native doves were made on Guam this fiscal year.

Island Swiftlets

Nine censuses of island swiftlets were made at Mahlac Cave during FY93 (Table 6). Counts fluctuated considerably during the year. An estimated 370 birds were present in October, but abundance declined to about 300 birds by February and March. Numbers then increased dramatically to about 425-450 swiftlets during July to September. Several explanations could account for fluctuations of this magnitude, including some inaccuracy in counts, heavy predation by snakes, or movements between other unknown caves. This type of variation in colony size has not been observed in previous years.

Table 6. Results of censuses for Island Swiftlets at Mahlac and Fachi Caves on Naval Magazine during FY93. Evidence of reproductive activities of swiftlets is also presented.

<u>Date</u>	Reproductive Parameters							
	Net No. of Birds Entering Cave	No. of Birds Estimated in Cave at Start of Count	Total No. of Birds Counted	No. of Whole Eggs Found on Cave Floor	No. of Eggshell Fragments on Cave Floor	No. of Nestlings Heard	No. of Nestlings Seen	Incubation or Brooding Observed
<u>Mahlac Cave</u>								
28 October 1992	370	5	375	0	2	1-2	0	no
7 December	-	-	-	0*	1*	0	0	no
5 January 1993	-	-	-	0	0	0	0	yes
1 February	274	16	290	0	5	1-2	1	yes
9 February	298	30	328	-	-	-	-	-
2 March	353	41	394	2	19	3-4	16	yes
30 March	307	44	351	2	23	6-7	19	yes
26 April	343	21	364	1	13	2-3	12	yes
1 June	-	-	-	2	43	6-7	16	yes
2 July	-	-	-	1	25	5-6	9-15	undetermined
29 July	458	32	490	5	22	4-5	16	yes
30 August	424	33	457	2	15	4-5	7-9	yes
28 September	434	9	443	3	12	2-3	6-10	undetermined
<u>Fachi Cave</u>								
18 March 1993	32	26	58	1*	+	2-4	0	undetermined

Key: *note that more than one month had occurred between visits; - = no data gathered; + = present but not counted

Reproductive activity was again monitored during the year. Observations verified work from previous years, showing that most reproduction begins in January and continues until October. Four nesting parameters determined from 56 nests viewed each month were highest from early March through September (Table 6).

Snake activity in and around the cave remained high in FY93. Although numbers of snake tracks in the cave's guano deposits appeared to decline from last year, other indicators suggested high snake presence. Nineteen shed snakeskins were found at the cave (18

outside, 1 inside). Six live snakes were seen in the cave or on outer rock faces. Five of these were captured and had the following sizes: 1) SVL = 1,667 mm, wt = 1,000 gr; 2) SVL = 934 mm, wt = 110 gr; 3) SVL = 1,308 mm, wt = 345 gr; 4) wt = 50 gr; and 5) wt = 30 gr. One of these animals (number 3 listed above) contained a freshly eaten swiftlet. The snake was caught as it slept on a ledge in a dark crevice under the main nesting aggregation of birds. This is the first time a swiftlet has been found eaten by a snake on Guam. Tightly squeezed masses of feathers in the gut of the snake closely resembled similar but previously unidentified feather clumps found occasionally in the cave. One of the other captured snakes had skink scales in its gut, while the others had empty stomachs.

Another remarkable find during the year was the observation of a swiftlet sleeping on a rock face 50 m south of the cave at 1900 hrs about 15 minutes after the completion of the census on 28 September. The bird was about 4.3 m above the ground under an overhang that would have given it sufficient protection from rain and wind. However, the swiftlet was quite accessible to snakes, and in fact, one was captured only 9 m away as we watched the bird. The swiftlet was already deeply asleep when first seen. We used a long stick to first gently tap the wall 2 cm away from it and then lightly touched the wings of the bird several times before it aroused and flew awkwardly away.

This observation could explain a great deal about swiftlets and snake predation. Birds are occasionally witnessed to have extreme trouble entering Mahlac Cave in dimming light during censuses. We speculate that these individuals may be newly fledged immatures that are inexperienced at finding their way into the cave. Some of these birds are never seen to enter the cave and may fly off to sleep on nearby rock faces, as we observed, or large tree trunks. These birds would be vulnerable to snakes, and it is conceivable that such predation may be heavy enough to negate most reproductive recruitment by the colony. A management activity to reduce this problem may be to clear fairly large openings through vegetation in front of cave entrances to allow easier entry by birds. Our observation also raises the possibility that once inside the cave, some birds may choose to roost on other walls away from the main nest aggregation. Birds are presumably safe from snakes in the nesting area, but other roosting surfaces in the cave may be reachable by snakes. Observations of the locations of sleeping birds have never been made in the cave after nightfall.

A potentially new problem seen for the first time this year was related to the building of nests by mud dauber wasps in Mahlac Cave from early June through September. An unusually large number of nests were actually attached to swiftlet nests. Some appeared heavy enough to be able to cause a swiftlet nest to fall from a wall. More observations of this situation will be made in FY94.

Only two visits to Fachi Cave were made in FY93. A census on 18 March produced a total of 58 birds, with breeding activity noted (Table 6). This is similar to numbers present in FY '90 and FY91 (DAWR 1990-1991), but is lower than the 82 birds counted in FY92 (DAWR 1992). The cave probably remained unflooded for nearly all of this year. It was found to be entirely open on 30 August, despite 14 inches of rainfall during that month. It may have become closed off in September as heavy rains continued, but this was not verified.

Three hikes were made along the coastal cliffline of the Lumuna region of Yigo to search for swiftlets. Trips were made on 16 November, 25 March, and 10 May. A few swiftlets were observed each time, thereby verifying the presence of a colony. A maximum of 6 birds were seen at once in March. Six caves were visited in the vicinity of the coconut grove leased by Mr. Artemio Taitano, but none appeared to be actively used. Four of the caves held old deposits of guano, but no evidence of past nesting was found. Our initial

work suggests that the colony is small, with perhaps fewer than 25 birds, and that it may be located northeast of Taitano's lease holding.

Mariana Crows

Fourteen transects totaling 209 stations were used to survey eight regions of northern Guam during July (Table 7). Transect locations are described in DAWR (1990, 1991). Crows were present on nine (64%) transects, an increase of 13% from last year. Fifty-one crows were recorded during playback surveys, a non-significant decrease of 11% from last year's total of 57 (Mann Whitney *U*-Test, $U=100.5$, n_1 and $n_2=14$, $p > 0.05$). Surveys in the CWSA detected the most crows (18 birds), an increase of four birds from last year (DAWR 1992). The NWF transect recorded nine crows, which was one more than last year's count. Transects 1, 2, and 7 recorded six or more crows. Transect 8, which had no birds last year, had six this year. This change in number between years may come from the movement of birds during the non-breeding season.

Table 7. Summary of results from playback of tape-recorded crow calls conducted during July 1993. Locations of the transects appear in DAWR (1990, 1991). The incidental number of crows is the number of birds detected while walking between stations.

Transect	Incidental stations	No. of crows	No. of with crows	No. of stations no. of crows
1	50	18	7	0
2	36	9	5	0
3	12	0	0	0
4	10	0	0	0
5	8	2	1	0
6	10	0	0	0
7	10	7	5	0
8	23	1	1	0
9	8	1	1	0
10	9	0	0	1
11	7	3	0	0
12	9	0	0	0
13	8	8	6	0
14	9	2	0	0
Total	209	51	26	1

Electrical barriers were used to protect 18 crow nests from snake predation in FY93, but no young were hatched. Ten of the nests were abandoned without eggs being laid or incubation observed. Clutch sizes of the eight remaining nests were as follows: 3 clutches of 1 egg, 1 clutch of 2 eggs, 2 clutches of 3 eggs, and 2 with an undetermined number of eggs. Of these nests, three clutches failed to hatch, two were preyed on during the building of the electrical barrier or soon after, one was preyed on after 2-3 weeks, one was preyed on after the electrical barrier failed, and the eggs of one were dumped by the parents. Of three nests that failed to hatch, two were located in unshaded portions of the nest trees, which probably caused the eggs to overheat and die. One of these eggs was collected and found to contain a fully developed chick.

Micronesian Starlings

Limited observations were made on the starling population at Cocos Island in FY93. In December, about 20 birds were estimated to survive on the island. This followed Guam's severe typhoon season from August to November 1992, which resulted in some further dieback of Cocos' vegetation, due mainly to "burn-off" of foliage by heavy salt spray

following Typhoon Gay in November. This population estimate is similar to the 20-25 starlings thought to be present after Typhoon Yuri in November 1991 (DAWR 1992). Sightings of a few juvenile starlings during the year give hopeful evidence that the population will stage a recovery. One observation of particular interest during the year was an early morning sighting of four starlings flying from Cocos Island across the lagoon to Merizo on 13 January. This is the first record of this type of movement, although it has been suspected to happen rarely.

The status of Micronesian starlings in northeastern Guam was reviewed for the preparation of a manuscript by Wiles et al. (in prep.). They report that the largest remaining starling population on the island occurs at AAFB in the housing and administrative areas and in adjacent parts of Yigo. An estimated 50-100 birds are present.

Seabirds and Reef-Herons at Cocos Island

One evening count for seabirds was made on Cocos Island on 9 December, following procedures used in previous years (DAWR 1991, 1992). No black noddies (*Anous minutus*) and only seven common fairy terns were recorded during the census, however, a walk through the island an hour after dark at 1930 hrs revealed about 200 roosting noddies and 100-200 common fairy terns. The noddies were gone from the island by 0545 hrs the next morning. We speculate that they may have been feeding far offshore, resulting in late arrivals and early departures. Use of the island by this species was far reduced from levels in December 1991, when an estimated 3,000-3,800 birds were present (DAWR 1992). Noddy abundance had increased substantially by August 1993, when large numbers were seen feeding offshore of Cocos.

Observations of nesting by Pacific reef-herons (*Egretta sacra*) were again made on Cocos Island this year. One nest was found on 29 April and three were seen on 6 May in trees near the abandoned Coast Guard station. All were in large trees and had adults associated with them. The presence of chicks was not determined, nor were follow-up observations made to determine nesting success.

Monitor lizards (*Varanus indicus*) and feral cats pose a threat to nesting and roosting birds on the island, as well as to some of the rare lizard species present. A monitor has previously been reported capturing a nestling yellow bittern on the island (DAWR 1992). Trapping for monitor lizards was discontinued in January for lack of results, however, control measures were continued using pellet guns. Between January and September 27 half-day trips to the island resulted in 13 monitors killed, 8 wounded, and 22 others seen but not shot. Two additional animals were shot earlier in the year and another was captured and taken off-island by a resort worker. Thus, a total of 16 individuals were removed from the island, excluding some possible mortality of wounded animals. The sizes of animals seen and killed decreased during the year, with most of the largest adults eliminated. In FY92, 11 monitor lizards were captured at Cocos (DAWR 1992). Stomach analyses of killed animals are being performed to determine food habits.

Two cats were seen on the island in December. One of these was found dead in May.

Notable Species Recorded on Guam during FY93

Wiles et al. (in press) document sightings of several new record bird species on Guam in FY93. Other noteworthy records during the year were as follows. Two red-tailed tropicbirds (*Phaethon rubricauda*) were seen flying over Cocos Island on 21 April. A flock of 40-50 white egrets roosted on Cocos Island for much of the winter and spring seasons. The birds commuted nightly to the island and roosted in *Casuarina* trees near the abandoned

Coast Guard station. The flock was comprised mostly of cattle egrets (*Bubulcus ibis*) that were believed to be feeding during the day in the hills behind Inarajan. Several intermediate egrets (*Egretta intermedia*), little egrets (*E. garzetta*), and a great egret (*Casmerodius albus*) may have roosted with the flock. One terek sandpiper (*Xenus cinereus*) was seen at Duncas Beach on 4 October. Three yellow wagtails (*Motacilla flava*) were observed at Pati Point on 28-29 September. This is the first record of the species for Guam. An unidentified wagtail was also seen at Cocos Island on 27 January.

RECOMMENDATIONS

1. Develop and implement methods for controlling the brown tree snake.
2. Continue bimonthly roadside counts along three routes in northern Guam.
3. Continue to monitor the population of common moorhens and develop an appropriate habitat improvement and development program.
4. Continue monthly cave censuses and efforts to assess population change and reproductive activity of island swiftlets. Consider snake-proofing Mahlac Cave to protect nesting swiftlets. Conduct further observations on the foraging behavior of swiftlets. Determine whether there is any seasonal variation in the foraging range of the colony. Interview farmers in the Talofofo River valley about the use of pesticides on their farms.
5. Continue to census Mariana crows to estimate population size and distribution. Continue breeding biology studies and attempts to snake-proof nest sites of crows.
6. Continue predator control efforts on Cocos Island until complete eradication of monitor lizards and feral cats is attained.

PROGRAM COST

The estimated cost of this project was \$54,589.

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Report prepared by: Gary J. Wiles, Celestino F. Aguon, and Micheal W. Ritter

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: W-1 R-1
SUB-PROJECT NO.: W-5
STUDY NO.: 1
JOB NO.: 1

JOB TITLE: Current Status, Distribution and Natural History of Marianas Fruit Bats (1460)

PERIOD COVERED: October 1, 1992 to September 30, 1993

SUMMARY

Guam's fruit bat population is currently estimated at 310-355 animals, which is similar to last year's number. Growing evidence suggests that numbers on Guam fluctuate in an annual pattern and are related to movements between Guam and Rota. Bat colonies used three roosts on Pati Point during the year. No cases of illegal hunting were documented or suspected during the year. In FY93, 10,933 frozen fruit bats were imported to Guam from other islands for human consumption, an increase of 41.5% from the previous year. A final report on a survey of fruit bats in Palau in 1991 was completed this year.

BACKGROUND

The Marianas fruit bat (*Pteropus mariannus mariannus*) has been under investigation by the Guam Division of Aquatic and Wildlife Resources (DAWR) since 1962 (DAWR 1964-1992). Considered a delicacy by Chamorro residents, bats steadily declined in numbers during the 1960s and 1970s until only a few solitary animals remained (Perez 1972, Wheeler and Aguon 1978, Wiles 1987a). Reasons for the decline included: increased human population pressures that resulted in overhunting and habitat loss, commercial exploitation of bats as a food, the lack of an adequate enforcement staff, and delays by the local legislature in passing protective legislation (Wheeler 1979). The Marianas fruit bat and the little Marianas fruit bat (*P. tokudae*) were placed on Guam's territorial Endangered Species List in 1981 and on the U.S. Endangered Species List in 1984, however *P. tokudae* was probably already extinct by then. The island's population of Marianas fruit bats grew substantially to an estimated 850-1,000 animals between 1980 and 1982, probably from immigration of bats from Rota (Wiles 1987a, Wiles and Glass 1990). However, numbers have declined since 1983 because of continued illegal hunting and suspected predation on bats by brown tree snakes (*Boiga irregularis*) (Wiles 1987a, 1987b). Guam's fruit bat population was estimated at 295-370 animals in FY92 (DAWR 1992).

OBJECTIVES

To continue status surveys and natural history studies and to provide for continued protection of habitat as recommended in the Marianas Fruit Bat Recovery Plan (Wiles 1990).

PROCEDURES

1. Survey fruit bat distribution and numbers in Guam and the Commonwealth of the Northern Mariana Islands (CNMI) as initiated in the late 1970s.
 - a. Conduct annual surveys of fruit bats along Guam's northern cliffline with periodic surveys made elsewhere on the island. The emphasis of surveys should be to search for solitary bats and additional bat colonies.
 - b. Conduct monthly censuses at known bat colonies on Guam.
 - c. Assist the CNMI Division of Fish and Wildlife with surveys of fruit bats on other islands as needed.
2. Record information on the behavior and reproduction of fruit bats in colonies.
3. Determine habitat use of fruit bats. Visit abandoned roost colonies and record information about terrain and the size and abundance of vegetation present.
4. Monitor fruit bat imports to Guam from other islands in Micronesia and the Pacific.
5. Investigate illegal hunting of fruit bats on Guam. Visit abandoned roosting sites of colonies to determine illegal hunting effort. Assist Conservation Officers with investigations of bat poaching.

RESULTS

Locations of Bat Colonies on Guam

Fruit bat colonies were recorded at three locations on Pati Point in FY93. Roost 1, a favored site in previous years (DAWR 1987-1992), was used by the main colony for much of the year (Tables 1 and 2). It was abandoned for unknown reasons in December and again in June. Inspections of the empty roost found no evidence of poaching or human intrusion. The passage of a fairly severe storm, Typhoon Gay, on 23 November did not cause the colony to move from this site. Roost 2 was inhabited for only about three weeks in December and January until gusty southeasterly winds possibly caused the scent of biologists to disturb the colony. This site had not been used since June 1981. Roosts 1 and 20 were occupied by bats at the end of the year. On 5 February, conservation officers saw a small aggregation of 8-9 fruit bats along the cliffline of Tarague Basin. Bats were absent from the site five days later.

Table 1. Approximate dates of use of three roosts used by colonies of Marianas fruit bats on Guam in FY93.

Roost Number	Roost location	Approximate periods of use by bats
1	North Pati Point	18 Sept 91-24 Dec 92, 15 Jan 93 - 8 Jun 93, 14 Aug 93 - present
2	North Pati Point	24 Dec 92 - 15 Jan 93
20	East Pati Point	8 Jun 93 - present

Table 2. Counts of Marianas fruit bats at roosts on Andersen AFB, Guam in FY93.

Date	Roost Number										Total
	1	2	14	15	16	17	18	19	20	21	
18 Sept 1992	186	-	0	0	1	3	0	0	0	0	190
18 Oct	203	-	-	-	-	-	-	-	-	-	203
21 Nov	291	-	-	-	-	-	-	-	-	-	291
18 Dec	582	-	-	-	-	-	-	-	-	-	582
28 Dec	0	480	-	-	-	-	-	-	-	-	480
15 Jan 1993	+	0	-	0	0	0	0	0	0	0	x
2 Feb	467	-	0	0	0	0	0	0	0	0	467
14 Apr	308	-	0	0	0	0	0	0	0	0	308
19 May	245	-	-	-	-	-	-	-	-	-	245
9 July	0	-	0	0	0	0	0	0	217	-	217
2 Aug	0	-	-	0	0	-	0	0	173	-	173
27 Aug	72	-	1	0	0	0	0	0	106	0	179
27 Sept	70	-	-	-	-	-	-	-	130	-	200

+ = Bats present at roost but no count made; - = site was not checked for bats; x = no total count made.

A squadron of 12 F-15 fighter planes trained on Andersen Air Force Base (AAFB) for at least 7 days in July. The noise from their take-offs did not appear to disturb the colony at Roost 20 or cause any unusual behavior among the bats. However, the planes were never observed making "hot" take-offs similar to those that disturbed the colony several years ago.

Surveys of Fruit Bats on Guam

In FY93, censuses of fruit bats at colonies on Pati Point produced total counts ranging from a high of 582 animals in December to a low of 173 animals in August (Table 2). Counts jumped from about 200 bats in October to 582 animals in December. Numbers then gradually slipped to 245 bats by mid-May. After the colony relocated itself at Roost 20 in July, numbers varied from about 170-220 bats.

A comparison of count data from Guam and Rota during the last few years with biologist Clifford Rice of the CNMI Division of Fish and Wildlife has revealed an interesting trend. Numbers on the two islands appear to fluctuate inversely with one another in an annual pattern that can best be explained by interisland movements. Further analyses of the data are currently underway.

An estimate of Guam's population of fruit bats at the end of FY93 was made using the September count of 200 bats at Roosts 1 and 20 (Table 2). Because some individuals were probably hidden by thick foliage during that count, the total number of adults in the roosts was likely to be 10-20% higher than the actual number recorded. In addition, based on previous observations (DAWR 1985), approximately 65% of the adults in the colonies were harem females. An estimated 10% of these animals probably possessed unweaned young. These figures provide an estimate of 220-240 adults and 14-16 juveniles, or a total of 234-256 bats, on Pati Point in September 1993.

Incidental daytime sightings of single fruit bats or pairs of bats were made during the year at the Conventional Weapons Storage Area on AAFB (15 sightings), Ritidian Point (15 sightings), Tarague Point (5 sightings), Tarague Beach (5 sightings), Northwest Field (4 sightings), Fena Lake (2 sightings), Urunao Beach (1 sighting), and forested locations in the Etton area of Ordot (1 sighting) and the Chochogo area of Toto (at least several sightings). Only one nighttime sighting was reported, that occurring at the Atantano River

marsh in Piti (1 sighting). The number of sightings at Ritidian Point and the CWSA indicates that a few solitary bats reside permanently in these areas.

Excluding bats residing in the colony at Pati Point, an estimated 50-75 fruit bats are still believed to live solitarily or in small groups along the island's northern cliffline that extends from Bija Point to Iates Point. An additional 25 animals probably inhabit Naval Magazine and other forested areas in southern and central Guam. Based on these figures, Guam's island-wide population of fruit bats at the end of FY93 was estimated at about 310-355 animals.

Surveys of Fruit Bats on Other Islands

The DAWR did not participate in bat surveys on other islands in FY93. A final report for the Palau survey conducted in April and May 1991 was completed this year and published by the U. S. Fish and Wildlife Service (USFWS) (Wiles and Engbring 1993).

Natural History

Guam experienced a severe typhoon season in 1992, with the passage of five storms between August and November, three of which had their eyes pass over the island. Typhoon Omar in August and Typhoon Gay in November were strong enough to cause moderate to severe damage to vegetation on the island. Soon after Typhoon Gay, foliage turned brown around much of the island, probably because of the heavy salt spray blown across the island and the small amount of rain that fell during and after the storm. Guam then experienced 7.5 months of very dry weather, which may have further hurt the recovery of plants from the typhoon season. The result of this was a noticeable dieback of the forest canopy in many parts of northern Guam. At Pati Point, most of the large *Ficus* trees showed extensive limb death, and in some cases entire trees were killed. This occurred at a number of bat roosts, as well as throughout the forest. The pruning effect on mature *Ficus* will almost certainly impact the roosting patterns of fruit bats in the future. Bats will likely be forced to roost in smaller trees with denser crowns, which may affect harem formation, other social patterns, and roost site choice.

Illegal Hunting

Poaching has long been a major cause of mortality of *P. mariannus* in the southern Mariana Islands (Wiles 1987a, Wiles et al. 1989, Stinson et al. 1992). No cases of illegal hunting were documented or suspected on Guam in FY93. Poaching still occurs commonly on Rota (E.M. Taisacan, pers. comm.).

Fruit Bat Imports

A total of 37,458 fruit bats were requested for import during FY93 (Table 3), an increase of 20.3% from the previous year (DAWR 1992). All requests were made for *P. m. pelewensis* from Palau. The number of import permits issued by the DAWR increased to 499 for the year, a gain of 28.6% from FY92. Approximately 17.3% of all import permits issued by the DAWR in FY93 had fruit bats listed as one of the items requested.

CITES restrictions continued to play a major role in the origins of fruit bats imported to Guam in FY93. An estimated 10,933 frozen fruit bats in 296 shipments were shipped to Guam from other islands during the year, with nearly all bats reportedly coming from Palau (Table 4). These figures represent a 41.5% increase in the estimated number of imported bats and a 48.7% increase in the total number of shipments received as compared to FY92 (DAWR 1992). A shipment of 400 bats from Yap entered Guam with a Palauan certificate

Table 3. Numbers of frozen fruit bats requested for import to Guam from Palau from October 1, 1992 to September 30, 1993.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
No. bats requested	1,344	4,015	3,763	2,905	4,584	2,844	2,600	2,889	3,232	3,723	2,672	2,887	37,458
No. permits issued	22	31	46	49	41	44	40	50	46	48	35	47	499

Table 4. Numbers of frozen fruit bats imported to Guam from October 1, 1992 to September 30, 1993.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total*	No. of Shipments Received*	No. of Bats Confiscated	No. of Shipments Confiscated
Palau	585	832	617	652	669	991	625	1,278	1,475	1,243	766	793	10,526	292	181	14
Yap	2	400 ^a											402 ^{a,b}	2 ^{a,b}	2 ^b	1 ^b
Kosrae		3											3	1	3	1
Saipan	2												2	1	2	1
TOTAL	589	1,235	617	652	669	991	625	1,278	1,475	1,243	766	793	10,933 ^b	296 ^b	188 ^b	17 ^b

*Totals include confiscated bats at Guam ports of entry.

^aA shipment of 400 bats illegally entered Guam from Yap (via Palau) with a Palauan certificate of origin. This was not discovered until later in the year.

^bTotals exclude a shipment of 421 bats from Yap that was confiscated in Palau in February and was destined for Guam.

of origin in November (see below). These were originally listed as being from Palau until an investigation by USFWS later in the year found they had originated in Yap.

A larger number of commercial importers was involved in the bat trade this year than in FY92. The top 10 importers in FY93 brought in almost half (47.7%) of all bats during the year. Their names were as follows:

Importer	Shipper	No. of bats	No. of shipments
1) Iked Mengidab	John Mengidab and Rena Kloulechad	999	12
2) John Q. Salas	R. Titimi, J. Ngiraked	765	10
3) Bruno Rdialul, Betty Roduk	same as importer	700	2
4) F & A Sales	Tim Garrett, others	523	5
5) Moy Reung	same as importer	442	2
6) JD Mart	J. and T. Stole	381	8
7) Fishland	V. Carr, Palau Fish Federation	376	5
8) Esther Tarkong	Rose Ngirarsol	352	3
9) Vic April	same as importer	350	6
10) Masa Uherhewar	M. Recheyungel, others	325	6
TOTAL		5,213	59

During FY93, 188 fruit bats in 17 shipments were confiscated by the USFWS and Guam Customs and Quarantine Division upon entry into Guam. These figures represented 1.7% of the total number of bats brought to the island and 5.7% of the shipments received during the year. Shipments were seized for a variety of violations including 1) the presence of bats killed with shotguns in shipments from Palau, which violated Palau firearms laws and the Lacey Act, 2) lack of import permits or certificates of origin, and 3) violation of CITES restrictions.

These figures do not include the confiscation of a shipment of 421 bats in Palau on 12 February that originated in Yap and was being transhipped to Guam with a Palauan certificate of origin (Bryant 1993). The shipment belonged to Mr. Bruno Rdialul, who upon questioning by special agents from the USFWS, admitted to having previously smuggled two shipments into Guam from Yap via Palau, one with 400 bats on 21 November and another with 300 bats sometime in FY92. Mr. Rdialul was arrested by the USFWS; the outcome of his prosecution is pending. These incidents suggest that more smuggling of bats from Yap may be taking place. The extent of this activity is not known but should be investigated.

RECOMMENDATIONS

1. Survey bat numbers and distribution along Guam's entire northern cliffline once or twice annually. Searches for additional colonies may be productive because continued poaching at bat roosts on Rota can cause large numbers of bats to move to Guam (Wiles and Glass 1990).
2. Continue observations at Guam's bat colonies. Information on reproductive biology, behavior, and social organization will be used to supplement data already gathered.
3. Summarize data previously collected and write reports on the diet, reproduction, and amount of snake predation on fruit bats.

4. Conduct a study of the vegetation, terrain, and proximity to development of known roosting sites to determine what site characteristics are important in the selection of roosting sites by fruit bat colonies.
5. Known bat roosting and foraging areas should be patrolled regularly by Conservation Officers. Part of their effort should be aimed at maintaining a visible presence at Jinapsan and Pajon Points, where poaching has been a serious problem in previous years.
6. Form a cooperative bat research program with the CNMI to collect information on the locations and sizes of colonies, reproductive biology and behavior within colonies. Most of the work done under this program would be conducted on Rota where a moderately sized bat population is found but where logistics prevent the CNMI from doing extensive field work. Emphasis of this project would be to identify colonies should they move between Guam and Rota.
7. Continue to monitor fruit bat imports entering Guam.

PROGRAM COST

The estimated cost of the project under W-1R-1 is \$10,422.

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Report prepared by: Gary J. Wiles

**JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT**

STATE: Territory of Guam

PROJECT NO.: W-1R-1
SUB-PROJECT NO.: W-5
STUDY NO.: 1
JOB NO.: 2

JOB TITLE: Roost Site Characteristics of Marianas Fruit Bats (1440)

PERIOD COVERED: October 1, 1992 to September 30, 1993

SUMMARY

No significant effort was expended on this job during this segment.

Report Prepared by: Gary J. Wiles

JOB PROGRESS REPORT COORDINATION PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: W-1R-1
SUB-PROJECT NO.: W-6
JOB NO.: 1

JOB TITLE: Technical Guidance to Projects Affecting Guam's Wildlife Resources
(1210)

PERIOD COVERED: October 1, 1992 to September 30, 1993

BACKGROUND

The professional staff of the Wildlife Section, Division of Aquatic & Wildlife Resources (DAWR), devoted a significant percentage of their time and effort to technical assistance. The rapid pace of development on the island is requiring increasing amounts of time from the Section's staff to fulfill its statutory responsibility to review and comment on development plans, rezoning applications, and various permit applications. Because of the size and complexity of some of these developments, the Section's review responsibility will require a continuing commitment that could extend even beyond project completion.

In response to the increase in workload, the Division created the Technical Assistance Program (TAP) within the Administration/Coordination Section. A local appropriation provides funding for two technical assistance staff members, a Biologist I and a Biologist II. These staff are primarily responsible for reviewing projects submitted to the Development Review Committee for action by the Territorial Land Use Commission and for the review of clearing and grading permit applications, but they also participate in the review of other permit applications and environmental documentation. The professional staff within the Wildlife Section provide technical support to the TAP staff, and often take the lead in the review of projects involving their particular expertise, such as those that may have endangered species impacts and those involving wetlands. This effort is extremely important for the management and conservation of Guam's natural resources.

OBJECTIVES

1. To minimize adverse environmental impact resulting from the construction of recreational, commercial, residential, industrial, military or public utility facilities.
2. Provide technical assistance to military and civilian agencies relative to the management and protection of Guam's wildlife resources.

FINDINGS

Wildlife Section staff have been actively involved in the technical guidance function during this segment. Numerous development plans, impact statements, and permit applications have been submitted to the Division for review. Field investigations and meetings with responsible agencies have been conducted in many cases as part of the review process.

Various Section staff members actively serve as members of the following groups:

1. Region IX Regional Response Team - Oceania
2. Fish and Wildlife Conservation Committee- Andersen Air Force Base
3. Pacific Islands Recovery Team for Birds and Bats, USFWS
4. Bird Aircraft Strike Hazard Committee - Andersen Air Force Base
5. Area Committee for Oil Spills

Members of the Wildlife Section have attended numerous meetings and hearings pertaining to the protection of Guam's natural resources and have actively consulted with various civil and military agencies on environmental matters. Section staff maintain close liaison with the Department of Parks and Recreation, Guam Bureau of Planning, Guam Environmental Protection Agency, University of Guam, U.S. Army Corps of Engineers (ACOE), U.S. Fish and Wildlife Service (USFWS), U. S. Marine Fisheries Service, U.S. Navy, the U.S. Coast Guard, and U.S. Air Force regarding matters of environmental concern. In addition, staff members actively consulted with numerous off-island visitors, representing various agencies and organizations, who visited during the segment.

Considerable public contact was maintained by Section staff during the reporting segment. In addition to occasional interviews on radio, television, and in newspaper, staff members gave talks to a number of civic groups, sportsman clubs, and school and university classes.

Some specific Technical Assistance activities of the Wildlife Section included:

1. Reviewing the Draft Environmental Impact Statement for the relocation of Navy Activities from Subic Bay to Guam and in assisting in the USFWS's Section 7 review of Navy VRC-50 proposal for flight patterns over endangered Mariana crow territories at Andersen Air Force Base in Northern Guam.
2. Participation cooperatively with the USFWS in the initiation of a wetland enhancement project of a portion of the Camp Covington wetland, Naval Station, Guam.
3. Provision of information on the endangered Mariana common moorhen, wetland vegetation, wetland design, and wetland functions to Pacific Island Engineers for their wetland creation and enhancement project in a portion of the Atantano marsh.
4. Participation with the ACOE and the U.S. Attorney's Office to resolve wetland mitigation issues at the Meng Feng fish ponds in Talofofo.
5. Provision of information on wetland design, wetland vegetation, water levels, and human-made floating and nesting platforms to the STT golf course in Agat.
6. Representation on the Development Review Committee, which met bi-weekly to review applications for rezoning, variances, and various types of development. The Division's input at this level is very important in ensuring that the protection of Guam's fish and wildlife resources be considered in land use planning. Wildlife professional staff provided significant technical input into this review process
7. Review and comment on ACOE applications for wetland fill. Mitigation recommendations were often included in these comments. Comments and concerns

were also provided to various local agencies. Wildlife staff provided significant input into the responses for these applications. Endangered species were of primary concern to the Section with Mariana common moorhens found in most wetlands on Guam.

8. Provision of technical support to the Division's enforcement staff by identifying and evaluating wildlife, testifying at court hearings and recommending disposition for confiscated wildlife.
9. Provision of technical assistance to the Department of Agriculture's Plant Protection Quarantine Division by identifying confiscated wildlife and wildlife products, holding wildlife in quarantine, and in general, supporting their efforts at preventing illegal imports of wildlife to Guam.
10. Review and comment on the proposal to create the Guam National Wildlife Refuge as an overlay on federal and local government land.
11. Review and comment on numerous Environmental Impact Statements and Assessments of proposed developments. These comments included recommendations for grading and clearing, erosion control, project design and orientation. These recommendations were made to reduce and/or eliminate impacts to the immediate and adjacent environments.
12. Provision of comments at the request of the USFWS involving several Section 7 Consultations under the Endangered Species Act.
13. Provision of assistance and information to the Technical Assistance Program on various areas of significant environmental concern.
14. Continued review and compliance monitoring for a number of permitted development activities on Cocos Island by Cocos Lagoon Development Corporation (CLDC). These include CLDC's proposal to restore the northern portion of Cocos Island by recovery of sand washed off the island by Typhoon Omar, construction of an additional seawall on the seaward side of the island to provide protection against future storm wave damage, and removal of post-typhoon debris. The prime concern in the review of all these activities was their potential impact on the existing avian colonies and on sea turtle nesting.
15. Review and comment on several legislative bills that would affect wildlife.
16. Response to many requests for information on laws and regulations pertaining to fish, wildlife, endangered species, hunting and fishing and importation of wildlife.
17. Response to many requests for information on native wildlife, particularly endangered species.
18. Answering numerous requests for information on hunting from both on and off-island individuals. Specific requests included information on hunting areas, hunter safety classes, firearms regulations, hunting seasons and limits, and laws and regulations.
19. Provision of technical assistance to numerous farmers and the U.S. Air Force and Navy regarding pig damage. Damage control permits were issued when warranted.
20. Review of manuscripts for other authors and for professional journals.

21. Assisting in presenting hunter safety briefings at Andersen Air Force Base and the Mangilao Community Center to provide pertinent information to hunters.
22. Numerous presentations on fish and wildlife resources at meetings of various organizations during the year.
23. Preparation of numerous press releases to keep the public informed of fish and wildlife issues including hunting and hunting seasons, brown tree snake issues, fish and wildlife laws and regulations, endangered species, fish and wildlife importation, etc.
24. Provision of technical assistance and logistic support to various USFWS personnel working on the brown tree snake problem.
25. Meetings with numerous developers, their consultants, and other government representatives to discuss their proposed development projects and their possible impacts on endangered species, wetlands and native habitat as well as erosion, project design, etc.
26. Provision of technical assistance to USFWS and National Marine Fisheries Service law enforcement personnel on various matters including the importation of endangered species items.
27. Provision of technical advice on wetland issues to the Development Review Section at GEPA.
28. Participation in the Navy Installation Restoration Program by providing information to Navy consultants and accompanying them on several site visits.

PROGRAM COST

The estimated cost of the technical assistance project under W-1R-1 is \$41,055.

RECOMMENDATIONS

Continue technical assistance activities in support of conservation of Guam's wildlife.

Report prepared by: Robert E. Beck and Robert D. Anderson

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-8

STUDY NO.: 4

JOB NO.: 1

JOB TITLE: Captive Breeding Endangered Native Birds

PERIOD COVERED: October 1, 1992 to September 30, 1993

SUMMARY

The number of Guam rails at the Division's captive breeding facility on Guam decreased from 95 to 90. One rail escaped and was not found. Four rails died during the year. The primary cause of death was aggression by other rails. The capacity of the Division's rail facility was increased to 128. As of December 31, 1993, there were 50 Guam Micronesian kingfishers in captivity at 19 zoos on the U.S. mainland.

BACKGROUND

The Guam Native Forest Bird Captive Breeding Program began in 1983 as a cooperative effort between the Division of Aquatic and Wildlife Resources (DAWR), member zoos of the American Association of Zoological Parks and Aquariums (AAZPA) and the U.S. Fish and Wildlife Service (DAWR 1983, Derrickson 1986, Shelton 1986). Predation by the brown tree snake, *Boiga irregularis*, now believed to be the single most important factor in the recent drastic decline of Guam's native forest birds (Savidge 1986, 1987; Conry 1988), precipitated the need for a captive breeding program when by 1982 at least five species of Guam endemic species or subspecies were nearing extinction in the wild. Unfortunately by 1984, attempts at captive breeding three of these species, the bridled white-eye, *Zosterops c. conspicillata*, rufous fantail, *Rhipidura rufifrons uraniae*, and the Guam flycatcher, *Miagra freycineti*, were abandoned due to their virtual disappearance from the wild (DAWR 1984).

The Guam rail, *Rallus owstoni*, and Guam subspecies of the Micronesian kingfisher, *Halcyon c. cinnamomina*, were successfully brought into captivity (DAWR 1983-6), with the capture of 19 and 31 founder birds respectively. Rails first bred at the DAWR's facility on Guam and at the Conservation and Research Center (CRC) of the National Zoological Park in 1984. Dr. Scott Derrickson, Curator of Birds, Conservation and Research Center, National Zoological Park, Smithsonian Institution, Front Royal, Virginia continued as coordinator for AAZPA's Guam rail program. By 1991 the captive Guam rail population had increased to more than 150 with Guam alone holding 81 in captivity.

Kingfishers were first bred at three mainland U.S. zoos (Bronx Zoo, Philadelphia Zoo and the Conservation and Research Center of National Zoological Park) in 1985. During FY88 the first studbook for the Micronesian kingfisher was published by the Philadelphia Zoo (Bahner 1989). The kingfisher has been designated as a Species Survival Program species by the AAZPA. Beth Bahner of the Philadelphia Zoo was designated by the AAZPA as studbook keeper for the kingfisher.

OBJECTIVES

Implement and manage a captive breeding program for the Guam rail and other endangered endemic birds by setting up facilities on Guam and at zoos on the mainland U.S. with the assistance of member zoos of the American Association of Zoological Parks and Aquaria. Produce enough Guam rails to support an effort to establish a wild population on Rota.

PROCEDURES

1. Develop plans for and construct at least six steel-framed 12 stall-holding aviaries to replace existing wooden aviaries that have deteriorated from weather and typhoons. Add additional holding aviaries as the need arises.
2. Develop plans and construct a building to support food preparation areas, incubator and brooding equipment usage and storage of supplies and equipment.
3. Continue the routine maintenance and operation of a cooperative captive breeding program for the Guam rail and Micronesian kingfisher with the AAZPA and its member zoos.
4. Develop techniques for the successful release of captive-reared birds in the wild once the factors responsible for their decline have been controlled.
5. Continue to consult with recognized authorities regarding captive breeding methodology, facility designs, and captive population management techniques.
6. Consult and coordinate with U.S. Fish and Wildlife Service, U.S. Department of Agriculture, and other government agencies with jurisdiction over the interstate movement and captive maintenance of wildlife. Acquire all necessary local and federal permits.
7. Breed rails in sufficient numbers to support the continuing introduction of the Guam rail to Rota, Commonwealth of the Northern Mariana Islands, begun in 1989.

RESULTS

The number of Guam rails at the Division's captive breeding facility on Guam decreased from 95 to 90 from October 1, 1991 to September 31, 1992, a decrease of 5 rails for the year. This was due to mortality of existing rails and the fact that rail breeding was on hold during the year due to efforts to recover from Typhoon damages and a lack of staff.

One rail escaped from its aviary during routine feeding and was never recaptured. Its whereabouts remain unknown. Four rails died during the year. Two died in separate incidents from cage mate aggression when they accidentally gained access to adjacent aviaries. A third was found dead in its aviary. A necropsy performed by Territorial Veterinarian Dr. Steve Neusbaum was unremarkable. The fourth rail was accidentally killed when it was stepped on by a staff member during a routine attempt to capture it.

Several significant Typhoons passed over or very near Guam just before and during the Fall of 1993. Typhoon Omar passed over Guam on August 28, 1992 with 160 kt. sustained winds and three wooden 12 stall holding aviaries at the Division's captive breeding facility were destroyed and had to be rebuilt during the year. Several 12 stall aviaries were reconstructed or newly built during the year bringing total capacity or the

facility by the end of the fiscal year to 128 rails. This will allow us to once again begin breeding in preparation for introducing rails to Rota.

Micronesian kingfishers continue to be captive bred at 19 mainland U.S. zoos (Bahner 1993). The Guam Micronesian kingfisher population in captivity at mainland U.S. zoos numbered 50 by December 31, 1992 (Bahner 1993).

RECOMMENDATIONS

1. Hire aviculturist/wildlife biologist to supervise captive breeding of Guam rails at DAWR Facility and the release and monitoring of rails on Rota and other locations as selected.
2. Continue the routine maintenance and operation of a cooperative captive breeding program for the Guam rail and Micronesian kingfisher with the AAZPA and its member zoos.
3. Construct additional 12-stall wooden holding aviaries as needed to support the Rota release of rails. Develop plans for moving rail facility to new site at Department of Agriculture compound.
4. Develop plans and funding for the construction of a building to support food preparation areas, incubator and brooding equipment usage, and storage of supplies and equipment at new site.
5. Continue to consult with recognized authorities regarding captive breeding methodology, facility design, and captive population management techniques.
6. Assist in the design of appropriate veterinary facilities at the proposed new Department of Agriculture building in order to upgrade support for the Division's captive breeding program.
7. Consult and coordinate with U.S. Fish and Wildlife Service, U.S. Department of Agriculture, and other government agencies with jurisdiction over the interstate movement and captive maintenance of wildlife. Acquire all necessary local and federal permits for shipment of rails between Guam and mainland U.S. zoos.
8. Breed rails in sufficient numbers to support the continuing introduction of the Guam rail to Rota, Commonwealth of the Northern Mariana Islands, begun in December 1989.
9. Coordinate with Dr. Scott Derrickson, Conservation and Research Center, National Zoological Park, Front Royal, Va., to convert Division Guam rail records to system used by member zoos of the American Association of Zoological Parks and Aquariums. This will facilitate coordination of record keeping between Guam and mainland U.S. zoos.
10. Develop capability to incubate Mariana crow eggs and rear young in support of efforts of Division to increase production of crows in the wild through efforts to "snake proof" crow nest sites.

PROGRAM COST \$96,500

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Report prepared by: Robert E. Beck, Jr.

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-8
STUDY NO.: 4
JOB NO.: 2

JOB TITLE: Development of an Experimental Population of Guam Rails on Cocos Island or in the Commonwealth of the Northern Mariana Islands

PERIOD COVERED: October 1, 1992 to September 30, 1993

SUMMARY

No Guam rails from previous releases in 1990 or 1991 on Rota were observed in FY93. Due to a lack of staff, rail releases on Rota were not conducted in FY93. Planning continues for additional releases in FY94.

BACKGROUND

Since the creation in 1960 of the Guam Division of Aquatic and Wildlife Resources (DAWR), census data from roadside counts, station counts, and transect counts have documented the reduction in range and numbers of the Guam rail, *Rallus owstoni*, and other native birds (DAWR 1961-1987; Jenkins 1983; Engbring and Ramsey 1984). Predation by the brown tree snake, *Boiga irregularis*, is believed to be the major factor contributing to recent declines in native bird populations (Savidge 1986, 1987; Conry 1988). Research efforts are presently underway to develop methods for controlling rail predation by the brown tree snake.

A captive breeding program for the Guam rail was successfully begun in 1983 on Guam and at mainland U.S. zoos in cooperation with the American Association of Zoological Parks and Aquariums (DAWR 1984-1987; Derrickson 1986). Guam rails were first brought into captivity in 1983 and bred at the DAWR's rail facility in the spring of 1984 (DAWR 1983, 1984).

The DAWR developed plans to introduce the Guam rail to Rota in order to develop a self sustaining wild population of rails that will not undergo "domestication" from captive breeding. It is hoped that the experience gained in introducing rails to Rota will provide valuable information useful for future introductions on Guam. The Rota population may also serve as a partial source of birds for use in reintroducing the rail to Guam, once snake predation has been controlled.

During FY87, a cooperative agreement was signed between the Government of Guam, the Commonwealth of the Northern Mariana Islands (CNMI), and the U.S. Fish and Wildlife Service (USFWS) outlining the responsibilities of each entity for the introduction. An environmental assessment was prepared for the USFWS covering the introduction of the Guam rail to Rota. The DAWR reached an informal agreement with Dr. Stuart Pimm of the University of Tennessee, which resulted in the assignment of Greg Witteman, a graduate student from the University of Tennessee, to Rota to monitor the initial two rail introductions in cooperation with the DAWR as a part of his dissertation research. Dr.

Pimm was successful in obtaining several grants from international conservation organizations to support his efforts in monitoring the introduction on Rota. Using these funds, a half-ton pickup truck was purchased on Rota for use by the monitoring staff.

After a permit to establish an "experimental population" of Guam rails from the captive bred population was published by the USFWS in the *Federal Register* (USFWS 1989), 22 Guam rails were released at the first site on the Sabana on Rota during three releases in December 1989 and January 1990. All but one rail were released with radio transmitters to monitor dispersal, mortality, and possible breeding success. Of the 22 birds, the whereabouts of 9 are unknown as their radios failed, 4 were killed by vehicles, 2 were killed by cats, 2 apparently died of starvation, 1 died of poisoning, and 4 died of unknown causes (DAWR 1991, Witteman et. al. 1991).

I Chiugai was chosen as the site for the second release of Guam rails on Rota, with 31 birds released on February 4, 1991 (Witteman and Beck 1991). This release appeared to be more successful than the January 1990 release at the Sabana. Witteman returned to the University of Tennessee in the spring of 1991 after the second release to complete his graduate work. Planning for a third release of rails continued through FY93.

PROCEDURES

1. Continue to captive breed Guam rails needed for the Rota introduction both on Guam and at mainland U.S. zoos.
2. Continue to develop techniques and methods for introduction of the rail to Rota.
3. Implement disease prevention protocol with rails on Guam prior to release on Rota.
4. Continue to introduce Guam rails to Rota.
5. Monitor the release of rails on Rota.
6. Continue to seek funding from conservation organizations to support the monitoring of the introduced rail population.

RESULTS

No rails were reported to be observed on Rota from the last release conducted in February 1991 (E. Taisican, Rota DNR, per. comm.).

In September 1990, a Government of Guam employee salary study was released that lowered the starting salary of new biologists at the DAWR by several thousand dollars. This made it extremely difficult to hire senior biologists to fill vacant positions from off-island due to Guam's high cost of living. This included the Biologist III Aviculturist/Recovery position that will supervise rail releases on Rota. As a result, there were no staff available to implement this project in FY92. This issue was finally resolved in FY93, when the Guam Civil Service Commission issued a decision allowing the DAWR to hire Biologist III's at above minimum-step recruitment levels. The DAWR subsequently advertised this position in several professional journals.

Planning for releases of rails on Rota continued. Meetings were held on Saipan to plan the CNMI's participation in the project. Meetings to plan the schedule for the Rota release and to discuss captive breeding techniques were also held with Dr. Scott Derrickson of the Conservation and Research Center, National Zoological Park, Front Royal, Virginia, where

the mainland U.S. zoo's participation in the rail captive breeding program is coordinated. An interview was also held at Front Royal with Dr. M. Kelly Brock, a post doctoral fellow with the zoo, who applied for and was eventually selected for the DAWR's aviculture position.

The DAWR now expects to resume the release of rails on Rota during the summer of 1994.

RECOMMENDATIONS

1. Hire aviculturist/wildlife biologist to supervise the captive breeding of Guam rails at the DAWR facility and the release and monitoring of rails on Rota and other locations as selected.
2. Continue to captive breed Guam rails on Guam and at mainland U.S. zoos for the Rota introduction.
3. Coordinate with the CNMI's Division of Fish and Wildlife for the third release and monitoring of rails on Rota.
4. Implement disease prevention protocol with rails on Guam prior to release on Rota.
5. Initiate a large third release of rails on Rota at I Chiugai with up to 50 rails from DAWR's captive breeding facility and U.S. zoos. Follow-up this release with an additional release within one month and at monthly intervals thereafter, with rails being continuously bred at the DAWR and occasional shipments from zoos. This release pattern should continue until monitoring on Rota indicates that wild-bred rail production exceeds mortality in the field.
6. Begin planning for release and first establishment of rails on Guam at Area 50 in Northwest Field, Andersen Air Force Base, as soon as snake-proofing of the site has been accomplished.

PROJECT COST

The estimated cost of the Guam rail Rota introduction project under E-1-8 is \$ 3,000.

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Report prepared by: Robert E. Beck, Jr.

**JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT**

STATE: Territory of Guam

PROJECT NO.: E-1-8

STUDY NO.: 7

JOB NO.: 1

JOB TITLE: Biology of Brown Tree Snakes

PERIOD COVERED: October 1, 1992 to September 30, 1993

OBJECTIVE

To gain the knowledge and understanding of the biology and ecology of brown tree snakes that is necessary for the development of effective control measures as recommended in the Recovery Plan for Guam's endangered birds and fruit bats.

PROCEDURE

Conduct studies into the basic biology of the brown tree snake.

RESULTS

The activities under this project were conducted incidental to Study 7, Job 1, Development and Testing of Control Methods for the Brown Tree Snake, and the results are reported in combination with that study. This project was not fully operational due to staff shortages. The Wildlife Section is in the process of recruiting a Wildlife Biologist III (Herpetologist) so that this important project can be fully implemented.

PROGRAM COST

The estimated cost of the brown tree snake biology project under E-1-8 is \$12,500.

Report prepared by: Celestino F. Aguon

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-8

STUDY NO.: 7

JOB NO.: 3

JOB TITLE: Development and Testing of Control Methods for the Brown Tree Snake.

PERIOD COVERED: October 1, 1992 to September 30, 1993.

SUMMARY

Field tests of electrical barriers designed to prevent predation of Mariana crow nests by brown tree snakes continued this fiscal year. Eighteen active crow nests were snake-proofed. Because active crow nests were protected early in the building phase, several clutches of two and three eggs were recorded, as well as one-egg clutches.

BACKGROUND

Roadside counts by the Guam Division of Aquatic and Wildlife Resources (DAWR) have documented the decline of native forest birds on Guam (DAWR 1974-1988). Studies by Conry (1988) and Savidge (1986, 1987) have indicated that predation by brown tree snakes, *Boiga irregularis*, is the main cause of this decline.

Attempts have been made to develop adequate and effective means of protecting active nests of the Mariana crow, *Corvus kubaryi*, from predation by snakes. Clearing of vegetation in direct contact with the nest tree, snake trapping, use of galvanized sheet metal girdles, and use of Tangle-Foot, an adhesive resin, have all been tried. The use of sheet metal girdles and Tangle-foot was partially successful, but resulted in the mortality of nest trees and was therefore discontinued. Clearing of vegetation and snake trapping has met with some success.

Recently, active nest trees have been protected successfully with the use of electrical barriers placed on the trees' trunks combined with clearing of adjacent vegetation (Aguon et al., 1992). Successful protection of active nests in FY92 resulted in the fledging of three crows from two nests (DAWR 1992). These were the first fledglings in the wild since late 1985.

OBJECTIVE

To develop methods of controlling brown tree snake predation at active nests of native birds.

PROCEDURES

1. Field testing and implementation of electrical barriers.
2. Field test the timing of placement of electrical barriers in addition to snake trapping.

RESULTS

Field tests of electrical barriers for protecting nests of the Mariana crow from brown tree snake and monitor lizard (*Varanus indicus*) predation continued this fiscal year. In prior years, barriers were placed on trees after incubation was first observed. This procedure resulted in a large number of nests being built, but incubation was often not successful (DAWR 1991, 1992).

During the crow breeding season from September 1992 to May 1993, intensive searches were carried out in northern Guam to locate crow territories and nest sites. Barriers were placed on nest trees during the night as soon as nest building was first observed. Both solar powered and battery powered electrical barriers were used. Maintenance of the barriers was carried out throughout the nesting season. Most barriers were removed at the end of the breeding season. Trapping for snakes and monitor lizards occurred around and in the nest trees. Care and feeding of the mice used as bait in the traps occurred on a regular basis. In addition, considerable time at night was spent visually searching the nest trees and surrounding areas for snakes and monitor lizards.

Eighteen Mariana crow nests built by 9 pairs of crows were snake-proofed this year. At least eight of the nests were later observed to have birds incubating. An attentive period of 20-30 minutes was used as an indirect method of determining that a nest was complete and that birds were incubating eggs. Five of these 8 nests were protected during the nest building phase. At the other 3 nests, birds were already incubating when snake proofing was performed. The 8 active snake-proofed nests almost tripled the number recorded during the previous two seasons (DAWR 1991, 1992).

Snake proofing during the nest building phase has also resulted in increase clutch sizes compared to previous years. Clutches of 3 eggs were found at 2 nests and 2 eggs were found in a third nest. Three nests had clutches of one egg. Clutches of 3 have not been previously reported for crows on Guam. In prior years, single egg clutches were most commonly found (DAWR, unpublished notes), although a 2-egg clutch was reported in FY92 (DAWR 1992).

The advantage of snake proofing early in the nest building phase is that snakes already present in the tree may be removed or trapped. Snakes were present at four of the 11 nests protected during nest building. These snakes were found in or close to the nest, even in the absence of any eggs or birds. At one nest, a snake was discovered swallowing a crow egg just after barrier construction had been completed. Earlier in the day, incubation had not been observed at this nest.

Despite the increase in numbers of clutches laid and numbers of eggs laid per clutch this fiscal year, no young were successfully fledged. The most common cause was failure of the eggs to hatch. Two nests were located in unshaded portions of trees, and probably resulting in overheating of eggs. This overheating problem may have been caused by extensive defoliation of the forest associated with the passage of six typhoons over Guam in the fall of 1992. A third nest was shaded, but the eggs also failed to hatch. A single egg that we were able to collect contained a fully developed chick. The cause of its failure to hatching could not be determined. Three nests were preyed on by snakes after the electrical barrier failed or by snakes thought to remain in the tree. The eggs of two nests were dumped from their nests, possibly by intruder crows or by the incubating adults.

RECOMMENDATIONS

1. Continue laboratory tests of possible means of protecting active native bird nests.

2. Conduct on site tests of methods, which prove effective in laboratory experiments on active nest trees.

PROGRAM COST

The estimated cost of the brown tree snake control project under E-1-8 is \$90,400.

LITERATURE CITED

Aguon, C. F., R. E. Beck, Jr., and M. W. Ritter. 1992. A method for protecting nests of the Mariana Crow from brown tree snake predation. Proceedings of the US-Japan Joint Congress on Snake Control for Human Health and Wildlife Conservation. The Snake 24:106.

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Report prepared by: Celestino F. Aguon

